DEVELOPMENT OF A BLISTER RUST CONTROL POLICY FOR THE NATIONAL FORESTS IN THE INLAND EMPIRE

by

Donald N. Matthews & S. Blair Hutchison

Northern Region
Forest Service
P.D. Hanson
Regional Forester

Northern
Rocky Mountain
Forest & Range
Experiment Station
Chas. L. Tebbe, Director

MISSOULA MONTANA

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THE AUTHORS

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FOREWORD

Public agencies in the Inland Empire have been fighting the blister rust disease of white pine for more than two decades. Control of the disease has been expensive but it has seemed justified. However, during recent years, the rising spiral of costs, which today is plaguing all activities in the United States, has raised anew the question of justifiability. How far should we go, how much money should we spend, in protecting the Inland Empire white pine from this disease?

This question is of great concern to the Forest Service, for if it is to the public interest to produce white pine on the national forests, proper steps should be taken to grow it. On the other hand, the Service does not wish to undertake or continue programs which go beyond the limits of good public policy.

Just where these limits of good public policy are cannot, of course, be determined solely by economic calculations. The public need for this type of timber is an extremely important factor to consider. As the report points out very forcibly, "Our resources have, in their relative abundance, been one of the main differences between this Nation and the others. They enabled the United States to become strong, and they are our hopes of staying strong...the Nation needs to spend as much for conservation measures as is necessary to preserve national strength and security." It is from this broad social-economic point of view that the authors have studied the problem of blister rust control. The authors were asked to analyze past efforts to control the disease and also the desirability, cost, and justification for future blister rust control with the objective of providing a basis for future timber growing policy in the national forests of the white pine belt. In the following pages are the tentative findings and conclusions of their study sponsored jointly by the Regional Office and the Experiment Station. The opinions presented are those of the authors.

While all foresters concerned with white pine management may not agree with all of the details, the study is, nevertheless, an important milestone in thinking about blister rust control and white pine management. We are publishing this preliminary report, therefore, as a matter of general interest.

P. D. HANSON
Regional Forester

CHAS. L. TEBBE
Director

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THE WESTERN WHITE PINE FOREST

Here are a few highlight facts
to facilitate understanding of
the report.

Location and Area

Most of the white pine land in the Inland Empire (figure 1) lies between the Lochsa River in Northern Idaho and the Canadian boundary, lapping over into Washington and Montana.

Northern Idaho	2.9 million acres
Northeastern Washington	0.4 " "
Western Montana	0.3 " "
TOTAL	3.6 million acres

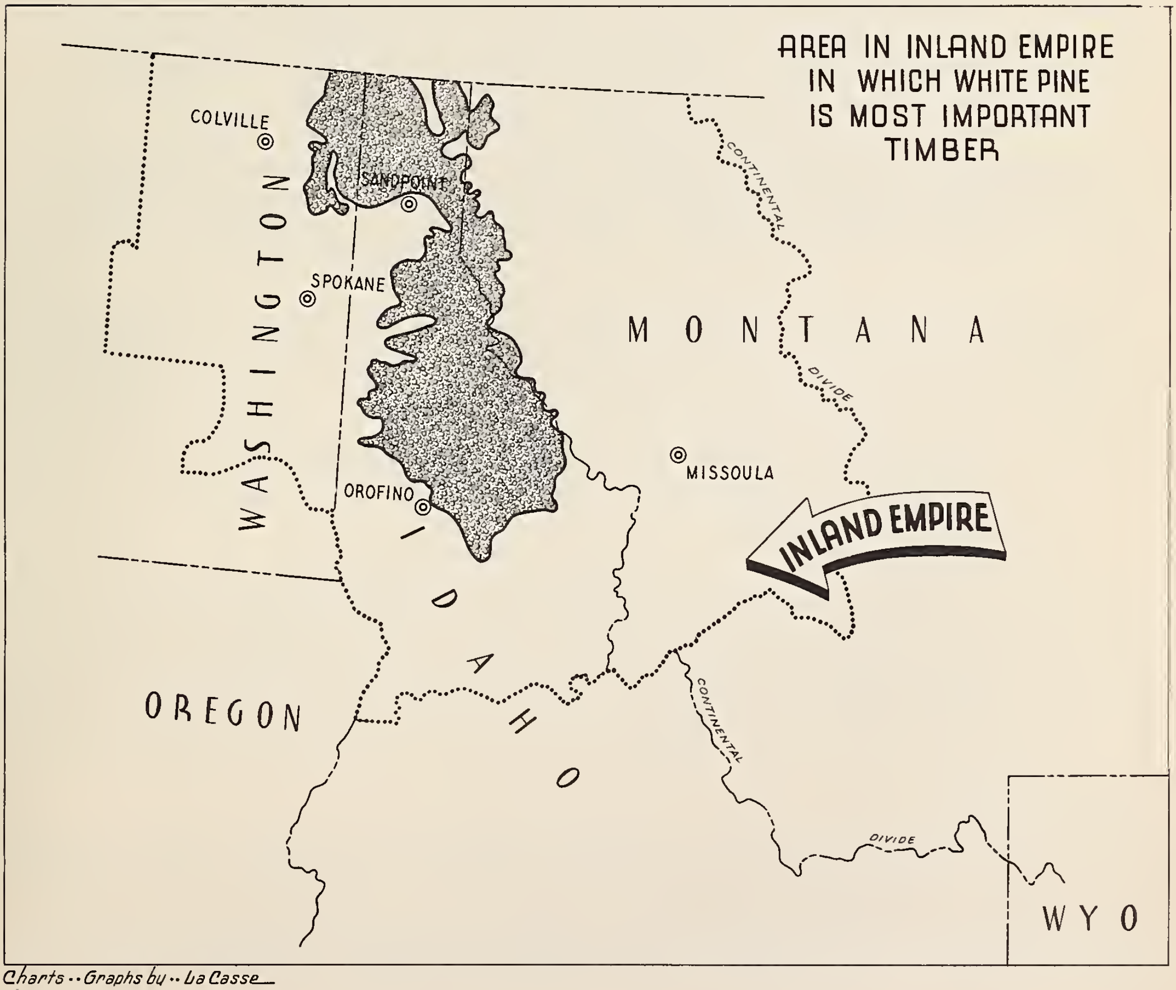

Figure 1.

Today, almost half of the white pine land bears young forest or is non-timbered. Nevertheless, one-third of the area still has a sawtimber stand.

Sawtimber	1.2 million acres
Pole	0.7 " "
Seedling and sapling	1.0 " "
Deforested	0.7 " "
TOTAL	3.6 million acres

Within the general range of distribution shown in figure 1, western white pine is the most important species, both from the standpoint of volume and value. Altogether there are 10.8 billion board feet of white pine sawtimber in the Inland Empire (log scale). However, this tree occurs typically in mixture with other species, very often comprising a low percentage of the stand. The species commonly associated with white pine are grand fir, Douglas-fir, western redcedar, western larch, Engelmann spruce, and western hemlock. Forty-six percent of the white pine sawtimber is on national forest land.

The western white pine timber type of the Inland Empire occupies less than 1 percent of the total commercial forest land in the United States. Even within the Inland Empire it includes only one-fifth of the commercial acreage.

The public is the biggest landowner in the white pine belt. In fact, half of the total acreage of the type is national forest.

National forest	1.8 million acres
State	0.4 " "
Other owners	1.4 " "
TOTAL	3.6 million acres

Only 2.6 million acres have been set up for blister rust control, including protection zones, although the total type area is 3.6 million acres.

Blister Rust

Blister rust is a canker-forming disease of white pine trees. The least damage done by these cankers is to kill branches, and at their worst they kill trees. In a matter of a very few years blister rust, uncontrolled, will completely destroy young stands. Older trees are more resistant, but over a

longer period even mature stands can be seriously damaged by the deforming and killing of trees.

Like many other rusts it depends upon two hosts for the completion of its life cycle. Part of the cycle in this case takes place on the white pine and the rest of it on currant and gooseberry bushes, collectively known as ribes. Thus it is possible to eliminate the disease in any white pine area by removing all ribes bushes within infecting range of the pines. Rust spores from pines will infect ribes bushes a hundred miles away, but spores from the ribes bushes seldom infect pine trees more than 900 feet away.

The Agencies Involved

Three Department of Agriculture agencies play the major roles in the white pine blister rust control program in the Inland Empire.

The Division of Plant Disease Control of the Bureau of Entomology and Plant Quarantine, through its Blister Rust Control Office in Spokane, Washington, and its control methods research office in Berkeley, California, provides the technical leadership for the whole project, and also has full charge of control camps on state and private lands.

The Forest Service has administrative responsibility for the selection of areas to be worked, running work camps, and checking the results of blister rust control on the national forests. It depends upon the Blister Rust Control Office for technical leadership in methods of control, and the two agencies work in close partnership.

The Division of Forest Pathology of the Bureau of Plant Industry, Soils, and Agricultural Engineering is responsible for federal research on the disease. This Division has an office in Portland, Oregon.

The Forestry School of the University of Idaho is also conducting research on blister rust.

FINDINGS IN BRIEF

This study has, in the main, been directed toward answering three questions and interpreting the answers to these questions in terms of Forest Service policy on national forest lands. The questions are:

Can blister rust be controlled?
If so, can blister rust be controlled at reasonable cost?
Are future white pine crops worth a sizeable present expenditure?

Each of these subjects is discussed at length in the report but here briefly are the highlights:

CAN BLISTER RUST BE CONTROLLED?

Experience and investigation in blister rust control justify the original conclusion that the spread of the rust on white pine can be stopped by eliminating currant and gooseberry bushes (ribes) on which the disease spends part of its life cycle. The problem in the Inland Empire, with its millions of ribes bushes on thousands of white pine acres, has been in the practical application of this theory. Reducing the number of ribes on protection areas has been a slow, hard job -- much more of a job than originally expected. Eradication has to be more complete than once appeared necessary. The areas being protected need to be worked more often and more thoroughly than anticipated.

Though blister rust control has proved more costly than contemplated, the evidence indicates that it can be successful if we are willing to pay the cost. Anyone who has traveled over the region looking at the young white pine stands will certainly agree that in those areas where there has been no eradication of ribes, the young pines are rapidly disappearing, but in many areas where work has been done blister rust has been brought under control.

CAN BLISTER RUST BE CONTROLLED AT REASONABLE COST?

This report indicates that on the basis of conservative future stumpage value estimates we can, if necessary, afford to spend from $5 to $7.50 per thousand board feet in extra measures necessary to grow white pine. Most of the present stands could be protected for less than that without considering the costs of growing future stands. We cannot, however, obtain the long-term regional and national values by stopping

with the protection of present stands. On most of the white pine area white pine cannot be grown on a permanent basis at a cost below these ceilings unless we do more than control blister rust. In other words, besides eradicating the ribes bushes, we must do planting and other cultural work to reduce the eradication costs and to increase white pine yields. With the dual approach, it is possible to grow a rotation of pine for 40 to 50 percent of the "ceiling" price.

The conclusion reached in this report is that a balanced, long-term blister rust control and management program can be justified from a public point of view which attaches as great or greater importance to social gains as to direct financial returns. Although this study places social gains ahead of interest earning, it is estimated that the monetary values created will be two or more times greater than the cost; and possibly six times greater. At the least, an integrated white pine growing program might be expected to earn one percent compound interest.

Another important reason for going along with such costs is that there is an excellent chance that they will be lowered in the future. Recent research in the field of hormone sprays is opening up new possibilities for blister rust control -- eradication of all species of wild currant and gooseberry bushes by mechanized spray methods. Hormone sprays have been developed which tests indicate will kill all species of ribes within the white pine type at low cost per acre. Thus, there is prospect that blister rust can be controlled with far fewer men than in the past, and it is quite likely that the costs will be materially reduced.

IS WHITE PINE WORTH THE EXTRA COST?

The conclusion reached in this report -- that it is desirable to forge ahead with blister rust control -- rests on the regional and national public values involved.

Regional Values

White pine has unquestionably contributed much to the development of the lumber industry and the communities in the Inland Empire. A large part of the importance of white pine has come from the low marketability of the species associated with it. The market position of these other species appears to be improving due to changes in the national wood supply situation and inter-regional competitive factors. The dependence of the forest industries upon white pine will probably decrease somewhat in the coming years but not the

desirability of growing white pine, as long as the costs are no greater than at present. A lumber industry with white pine has greater prospects for security, stability, and prosperity than an industry dependent solely upon the other less valuable kinds of timber. To the extent that the lumber industry is more secure and prosperous, the communities of the white pine belt will be more secure and prosperous.

National Values

National values are not easy to measure for the reason that very few of our individual resources are indispensable. There are some who foresee the day when timber will be chiefly valuable for its fiber and its chemicals -- the day when quality woods like white pine will cease to have premium value. Time alone will or will not substantiate that prophecy. We know definitely, though, that technological progress has not materially changed the manner of wood use in the past quarter of a century. It has not reduced the value of quality.

The conclusion reached in this report is that the long-time natural resource situation in the United States will be better to the extent that white pine is grown. Western white pine lumber has qualities of workability, texture, light weight, etc., which make it a preferred wood. It is one of the soft pines which as a group have filled a very important segment of this Nation's lumber needs. The timber situation in the future will be less satisfactory than in the past to the extent that the supply of soft pines is less than adequate in years to come. The utility of the soft pines is, of course, the reason for growing any one of them, as long as that can be done at reasonable cost.

HOW MUCH MORE BLISTER RUST CONTROL?

Because of blister rust, white pine growing in the Inland Empire differs materially from most long-term projects. Mighty dams, modern highways, and the like can be built over long periods of time. By and large, events will wait for you. Not so with blister rust control. Everything hooks together -- the timing of control as well as concomitant management of the forest. This fact makes the task that much harder and emphasizes the need for a properly timed and a properly balanced program. This report points out the difficulties involved in growing white pine, but these difficulties are not regarded as insurmountable.

It is recommended:

1. That the Forest Service launch an agressive campaign to grow continuous crops of white pine. From now on make it a WHITE PINE PROJECT instead of a blister rust control project.

2. That the white pine project should be developed on whatever scale appropriations permit with the work always concentrated in those units which will give the largest stable output of white pine for the money spent.

3. That a great deal of emphasis should be put into developing cheaper control methods, a stable program, and more effective blister rust control workers.

4. That there should be an aggressive program to bring good management to all those lands, regardless of ownership, which have been dedicated to growing white pine because of high productivity and relative economy of treatment.

5. That, however, the limitations of mixed ownership be realistically faced. And that provision be made to simplify the land ownership pattern where adequate management by every owner is not assured.

6. That the objective in this region should be to grow an amount of white pine in keeping with regional and national needs.

7. That in fulfillment of this objective we should spend four million dollars annually during the next five years for blister rust control and white pine management on the national forests. After that, for 15 years the expenditure should be about 1-1/3 million dollars annually.

THE FOLLOWING CHAPTERS

The points mentioned briefly in these few pages of summary are all covered in detail in the rest of this report which may be divided into four parts:

Chapter I discusses past efforts to control blister rust in the Inland Empire and the lessons learned from that experience.

Chapters II and III consider the national and regional social and economic values relating to a white pine timber growing policy in the Inland Empire.

Chapter IV presents the costs involved in growing white pine, yields obtainable, and the factors affecting costs and yields.

Chapter V presents the authors' recommendation with regard to a policy and program for future blister rust control and white pine growing in the Inland Empire.

I. BACKGROUND

PRESENT BLISTER RUST SITUATION

It would be hard to exaggerate the past importance of white pine in the Inland Empire. This species brought most of the sawmills here in the first place, and it has kept most of them running ever since.

Sawmills began cutting in this region more than 100 years ago, but they no more than nibbled at the resource until the start of the present century at which time people began to see that the great white pine stands of Michigan, Wisconsin, and Minnesota were running low. From 1899 to 1908 the white pine belt experienced a land boom as lumbermen from the Lake States and other places raced to block out operating tracts of the pine. Some of the mills built by these men and their successors have cut little but white pine. Some cut more heavily of other species. All, however, with one or two exceptions, were white pine mills. Over the years, the proportion of this species in the sawmill output has been more than twice as large as its proportion in the stands. Figure 2 shows the long-time trend of lumber cut in Northern Idaho.[1] Notice that in 1932, 80 percent of the lumber produced was white pine.

1/ As shown on the map in figure 1, the white pine belt lies in three states, which makes it difficult to present certain types of statistics. However, most of it lies in Northern Idaho. For that reason, population, production, and other statistical data for Northern Idaho are used to indicate the situation in the whole white pine belt.

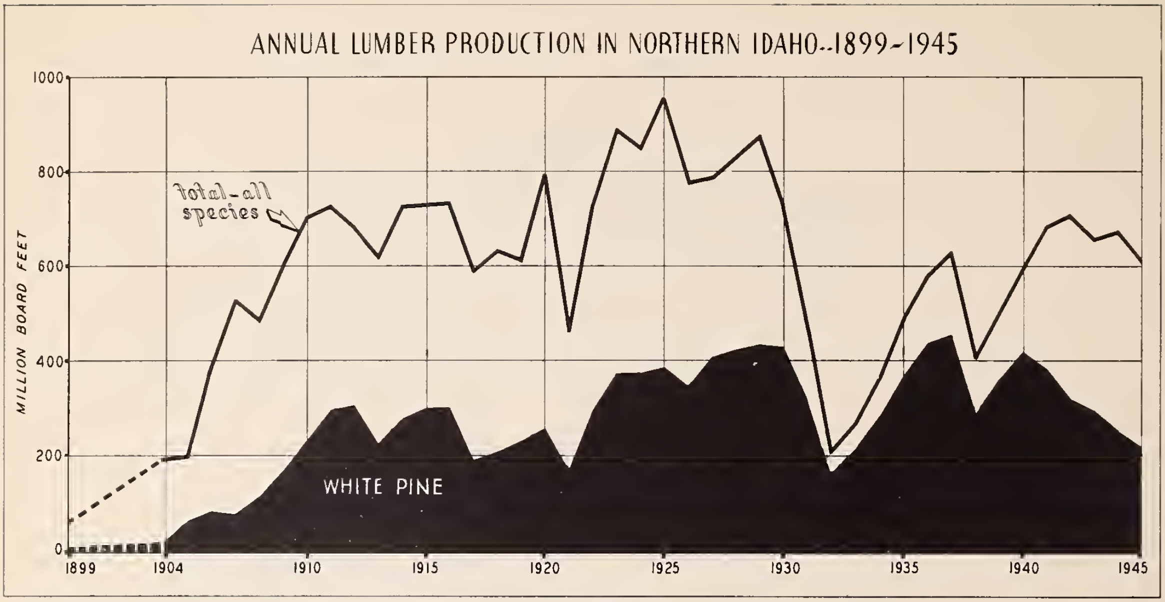

Figure 2.

DEVELOPMENT OF BLISTER RUST CONTROL

It is not surprising that a number of people were worried when the blister rust threatened to raise its ugly head in the Inland Empire. Experience with the disease in the eastern white pine stands left little doubt that uncontrolled blister rust could, in the long run, do just as much damage to white pine as uncontrolled fire. So great was the concern, that the movement to combat blister rust in the Northwest got under way several years before the disease was discovered here.

Infection, imported from Europe, probably as early as 1898, had been discovered in the eastern states in 1906. As it spread and gave evidence of being able to do tremendous damage to the young white pines of America, a number of foresighted individuals began to be concerned about our western stands. They reasoned, correctly, that if the Atlantic Ocean did not keep the disease out of North America, the Great Plains and the Rocky Mountains would not assure protection for the western white and sugar pine timber unless steps were taken to make these barriers effective. A meeting was held in Portland, Oregon, in 1919 for the purpose of setting up a program of action to keep blister rust east of the Rockies. This meeting, the International White Pine Blister Rust Conference for Western North America, appears to have been the beginning of the organized effort in the West to control the disease

so that this section of the country might continue to grow the five needle pines in commercial quantity (16).2/

The original hope that the blister rust might be kept out of the West soon had to be given up and the objective changed to one of retard and control. During 1921 several well-established infections were discovered in western Washington and western British Columbia. Later information indicated the disease had migrated to these localities on white pine nursery stock imported from France to Vancouver, B.C., during 1910 (22) (42). After 1921, therefore, the aim was to retard the inevitable spread of infection throughout the western white pine and sugar pine forests to allow time to develop and apply local disease control measures. Apparently there was no expectation on the part of those connected with the project that the disease could be completely stamped out once it became established.

The strategy in the subsequent control program was directed at what seemed to be the pathologically weak spots in the character of blister rust (22).

First of these is the fact that blister rust spends part of its life cycle on white pines and part on currant and gooseberry bushes, collectively known as "ribes." If the ribes bushes within infecting range of white pine in any locality can be eliminated, blister rust will cease to spread and will ultimately die out in that particular area.

In the second place, although spores produced by cankers on white pine are very hardy and will infect ribes bushes more than 100 miles away, spores from the ribes bushes are weaker and can infect the five-needle pines within a very narrow range -- usually 900 feet or less.

Lastly, the experts recognized early in the game that although none of the ribes species in the Inland Empire are immune to the disease, they do vary greatly in susceptibility. Most susceptible is the garden variety black currant. Of the four major wild types, Ribes petiolare and inerme are more susceptible and Ribes viscosissimum and lacustre less so (23).

The effort to slow down the inevitable spread of blister rust throughout the Northwest started with the establishment

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2/ Numbers in parentheses refer to references listed at the end of this report.

of quarantines to prevent the shipment of ribes bushes into and within the region. About the same time (1922) a program was started of pulling up all cultivated black currant bushes from the gardens and nurseries of the northwest states. This species has a great capacity to spread spores. Pathologists felt, therefore, that although the forests were full of wild ribes, cultivated black currants would be the principal agent of long-distance spread of the disease. They hoped to gain valuable time by eliminating these cultivated bushes (54). Altogether, about 100,000 plants were destroyed in Montana, Idaho, and Washington over a period of several years.

As we look back, it seems doubtful if these early efforts did much to slow down the entry of the disease into this region or retard its development. For one thing, the eradication and quarantine of cultivated currants was not undertaken soon enough. Firmly entrenched blister rust infections were found in eastern British Columbia in 1922, and though the disease was not discovered in Northern Idaho until 1927, it was later learned that at least fifteen centers of infection had started there during 1923. Even had the program of eradicating the cultivated currants (Ribes nigrum) been started much earlier, there is a question whether it could have retarded the spread of the disease very much, once blister rust had gained a foothold in eastern British Columbia, because the number of cultivated bushes was insignificant compared to the millions of wild ones. J. L. Mielke points out (22), "In no instance have infected pines in Idaho been found in association with R. nigrum.........Accordingly, Ribes nigrum was of relatively very little importance in initiating blister rust on pines at outlying points in the western states."

The job of eradicating wild ribes plants growing in white pine forests was tackled in 1922. Small scale experiments to develop cheap and effective means of "local control" were undertaken by the Spokane Blister Rust Control Office of the Bureau of Plant Industry. On the basis of these early trials, this Bureau and the Forest Service felt confident that although there were many ribes bushes in the white pine forests, they could cope with blister rust for a reasonable cost by hand pulling and otherwise eradicating the bushes (30) (31). They put much emphasis on the fact that the job would not be unduly expensive, and that the value of the white pine justified the cost of control. In 1930 they estimated that the bill for getting control to the point where it could be maintained for a

small annual expenditure would be about $8,000,000 spread over a 10-year period (44). This estimate was, of course, based on forest conditions and costs existing at the time the estimate was made. Eastern experience encouraged the belief that the job could be accomplished and that the cost would be reasonable considering the values involved.

Ribes control work during the 11 years from 1922 through 1932 was strictly a small scale operation, and was, in terms of the total job contemplated, like bailing the ocean with a teacup. This decade has been described by the Blister Rust Control Office as "a period of preparation and slow advancement" (17) during which about 215,000 acres were covered by work crews. Basic research was started during that period on the ecology of blister rust and on hand and chemical control methods. The disease itself was at the same time going through a period of establishment and slow advancement in preparation for a mushroom-like development in the following years. If a much larger scale attack could have been made on the ribes population, at least during the latter half of this period, the blister rust problem might be less critical than it is today and the costs of controlling the disease might be closer to the early estimates.

Blister rust control in the Inland Empire jumped into the "big time" during 1933 and the following few years (33), when the Civilian Conservation Corps and other emergency relief programs started. The labor used in ribes eradication during 1933 totaled 194,000 man-days and in 1934 it jumped to an all-time high of 474,000. When these figures are compared with the 25,000 man-days in 1931 and 36,000 man-days in 1932, the tremendous expansion under the relief programs is evident. Considering the small population in this white pine country and the shortness of the season during which ribes can be eradicated, a project involving 474,000 man-days is, relatively speaking, very large. Altogether, there were in 1934 about 11,000 blister rust control workers in the Inland Empire, which was about one and one-half times the number employed in the region's lumber industry.

In 1933 the Office of Blister Rust Control 3/ had behind it considerable experience and a decade of planning for a full-scale war on the disease. The basic pathological considerations were understood, and a general strategy had been mapped out (55) (56). Nevertheless, many very important points about methods and standards of control could only be learned by living with the disease for a number of years. If the program had been held up waiting for more experience, the battle would have been lost before it started. Logic had to take the place of experience. It must have taken a good deal of courage on the part of the control leaders to undertake a project which dealt with so many unknowns.

We can, however, see that no one realized the magnitude of the problem. Experience in other regions was a poor basis for sizing up the total job in the Inland Empire. Conditions relating to the spread of the disease in the West are worse than elsewhere in the country -- the topography is rougher, the ribes are more numerous, and the pines are more susceptible. For example, in their first working of the Inland Empire, eradication crews removed an average of 196 ribes plants per acre, which is two and one-half times the average number removed in the Lake States and ten times the number in the Northeastern States.

We can get an idea of the size of the job which was undertaken by looking at the stream bottom problem. Many miles of streams in the white pine country were literally jammed with currant and gooseberry bushes. Elimination of the stream bottom hazard was absolutely necessary to safeguard a much greater area within infecting range. With so many stems per acre, hand pulling was out of the question, so

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3/ During 1934, the Office of Blister Rust Control was transferred from the Bureau of Plant Industry to the Bureau of Entomology and Plant Quarantine. Research work on the pathology of blister rust is still done by the former bureau now known as the Bureau of Plant Industry, Soils, and Agricultural Engineering. From the start, the Blister Rust Control Office has spearheaded the attack against blister rust and provided the technical leadership. Prior to 1937, this office also provided the direct supervision of all eradication camps, with the Forest Service operating in a facilitating capacity in connection with national forest projects. Since 1937, the Forest Service has operated the national forest camps itself with the technical guidance of the overall project still supplied by the other bureau.

chemical and mechanical methods were developed. Even so, the task was not easy. Bulldozers were used to scrape some areas clean and convert them to meadows. This was, in many instances, a happy solution for the cost was liquidated by the value of the meadows. Nevertheless, the average cost of something like $70 per acre for bulldozer eradication emphasizes that blister rust control is not penny-ante forestry.

Apparently no one anticipated just how much trouble would develop on cutover lands. Altogether, during the past two decades probably 400,000 or 500,000 acres have been logged in the white pine belt. This cutover area, cluttered with logging debris and bearing thousands of newly-sprouted ribes bushes per acre, has been the big headache of blister rust control. As early as 1928, plans took into account the influence of cutting and fires on the program, but the high cost per acre was not foreseen.

As we have pointed out, the fundamental scientific facts of blister rust control were very well understood early in the game. However, in applying this knowledge under field conditions, there was much to be learned about four major aspects of the situation:

1. The distance which blister rust spores will travel from ribes bushes to pines under different conditions.

2. Eradication standards, or the number of ribes bushes which can be left on an area without jeopardizing the pine.

3. The number of workings required to reduce the ribes population to a "safe" number.

4. The amount of eradication needed in mature stands.

Certain original assumptions with regard to these four major aspects of the situation were inaccurate and had to be modified as experience indicated the true situation.

<u>Distance of Spread</u>

Early studies in the East indicated that most of the infection from ribes bushes occurs within 300 feet of the diseased plants and that there is little danger beyond 900 feet (36). Subsequent investigations in the West largely verified the early findings. J. L. Mielke states (1943), "The results of observations made during the past 20 years in the West show that the distance of spread of the rust from ribes to

pines seldom exceeds 600 to 900 feet" (22).

It was recognized very early though, that there were exceptions to the 900-foot rule. Where fog pockets occur or where there are strong air currents during wet weather, spores from the ribes bushes live longer and travel farther than usual. For this reason and to reduce the amount of protection zone needed, the control agencies have attempted to block out the work areas into as large units as possible. Moreover, in many instances wider zones than 900 feet have been set up where local conditions seem to warrant it. Nevertheless, blister rust control efforts have, in certain instances, been disrupted by spores which have jumped over the buffer strips. That apparently has not happened in many cases but often enough to emphasize the danger of underestimating the protection zone width.

One of the more often referred to cases of buffer zone breakdown occurred around the Forest Service's Savenac tree nursery. Virtually all of the ribes bushes had been removed from a mile-wide strip around the nursery in the early thirties and the area was reworked intermittently after that. Yet, these efforts failed to safeguard the nursery, which is an exceptionally susceptible target, from a light infection in 1941. The spores are believed to have come at that time from ribes concentrations in the vicinity of Haugan Lookout more than one mile away. Another instance of long distance spread was the Mowat Creek white pine plantation on the St. Joe National Forest in Idaho. Although this plantation and a wide strip around it were supposedly free of ribes bushes, the stand came out of the 1941 wave year with 70 percent of its trees infected. The infection is now presumed to have come from a dense ribes concentration at the upper end of Mowat Creek, one-half to one mile distant from the infected trees.

Failure to get enough protection from a zone of 900 feet or more has come in a few "wave years." These are the years when the ribes bushes have produced large spore crops and the weather has been wet in late summer and early fall. Under these conditions, some protection zones which were adequate during most years apparently broke down. All of the white pine belt was hit by at least five waves between 1923 and 1943. They are 1923, 1927, 1933 [4], 1937,

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4/ For some of the region, the "wave" came in 1932 instead of 1933.

and 1941. As the rust does not show up on the pines for several years after infection, the wave years since 1941 have not been identified.

Control men have come to recognize many of the characteristics of areas where long distance spread is likely to be a factor. Some of them feel that the situations where spores from the ribes will travel extra long distances are not very common and that long distance spread is one of the less serious problems to contend with in blister rust control. In any case, it is an elusive matter and one which seems to need considerably more study. Since the objective is to control the disease at minimum cost, it is important that the buffer strip be wide enough but not too wide.

Eradication Standards

How many ribes bushes can be tolerated per acre? This has been an important question from the start. The first bush removed per acre is a cheap one. Finding and pulling the last one is an expensive process. Thus, if some bushes can be left without endangering protection, the cost of the control job can be greatly reduced.

Experience with the disease has resulted in a gradual intensifying of control standards. In other words, as we have become better acquainted with the rust-spreading capacity of the native ribes and as the disease has spread into all corners of the white pine belt, the trend has been toward more complete elimination of bushes in areas where white pine is to be grown.

For example, ribes eradication was at first regarded as sufficiently complete after a first working if checks revealed that the bushes missed by the crews had an aggregate stem length of not more than 50 feet per acre. In 1933 the allowable footage of left stem was reduced to 25 feet. The situation in subsequent years is described by R. L. MacLeod in the 1940 annual report of the Blister Rust Control Office:

> "During the period from 1933 when spot infections became widespread to 1939 when the results of the 1937 wave were evident, many areas with 25 or 50 or even 100 ribes per acre showed no introduction of the rust. This resulted in a false sense of security, a belief that the arbitrary standards of efficiency were sufficiently strict. The results

of the 1939 survey showed that this was not true, consequently the standards were made more strict. The 1940 surveys confirmed the indication that small numbers of ribes were not safe when the rust was present in any reproduction area."

Today eradication is not considered adequate in most cases if a check shows that there are more than 5 feet of live stem remaining per acre. Prevailing practice, in other words, calls for virtually eliminating the bushes in pine stands or anywhere within infecting range.

Blister rust control men point out, however, that not all of the change to tighter requirements was the result of the changing conception of adequate standards. A shift in control strategy was also involved. At the start it seemed desirable to get over a large area in a short period of time to "knock the disease down." Less emphasis was placed on the completeness of a single working. As the disease became entrenched throughout the region, the risk factor increased and it became necessary to do a more thorough job in any one working.

Number of Workings

How many times do blister rust crews have to cover an area before control is on a "maintenance" basis? 5/ Early in the game it was recognized that "ribes eradication" is a relative term. For one thing, some bushes will always be missed. Then also, the ribes seeds have the capacity to stay alive in the forest floor for a century or more (9). All that can be done is to reduce the bush population to a low safe level. We may not yet have the final answer to this question, but already follow-up work has turned out to be a much bigger part of the total job than was forecast, both in number of workings and time required. At least one official statement of the early days indicated that once over most areas (one working) would put control on a maintenance basis (31). In other words, it was expected than one working, plus the shading by the trees, would reduce the ribes population to the point where only a

5/ An area is "on maintenance" when its ribes population has been reduced to a standard where it is only a negligible source of infection. Until they have been disturbed to a major degree by logging, fire or some other cause maintenance areas require only a periodic inspection and a minor amount of rework to maintain the status quo.

small maintenance expenditure would be necessary, until such time as logging or other disturbance stimulated the growth of more ribes bushes. Follow-up workings, where necessary, were expected to be relatively inexpensive. This faith in the adequacy of a single working appears to have been somewhat at variance with an earlier opinion that most areas would have to be reworked in 5 to 10 years (11) (40).

It wasn't long before the men supervising blister rust control knew definitely that two, three, or more workings would be required on many areas because of the long life of ribes seeds on the forest floor and because of bushes inevitably missed. It is now believed that something like two out of every three acres must be covered more than once during the life of a stand. So long as present methods are used, reworking will in the aggregate be a big job. Development of chemical control methods may, however, alter the situation.

Work in Mature Stands

Ribes eradication in mature stands has been one of the more controversial aspects of the blister rust control program. Some critics have claimed that ribes have been pulled from many mature stands because they were relatively easy to work and that ribes eradication in such stands has been largely a waste of time. On the other hand, this work has been strongly defended. There is a time factor involved in ribes eradication in mature stands which further complicates the issue. Any white pine tree of any age can be killed or damaged by blister rust. However, while the process requires but a few years on young trees, it is much slower on old ones. In mature timber there may not be any substantial loss before the trees are cut, even if these stands are not protected.

The place of mature timber in the control program during the past twenty years has changed materially. The Plan For White Pine Blister Rust Control written in 1928 has this to say: "Because of the scarcity of Ribes, and because those which do occur there are low in susceptibility to blister rust, Ribes eradication will be unnecessary in practically all of the mature timber stands, if the menace of the nearby stream type is removed" (31). By 1933, when the blister rust control program had become a big operation, control men of the two agencies took a less tranquil view than expressed in the 1928 plan. The dominant opinion since then has been that it is desirable to work mature

stands both for their own sake and to protect young stands nearby. A study by T. S. Buchanan in 1938 has lent weight to the view that merchantable timber is vulnerable (3), but it is also recognized that the damage develops slowly in this timber.

The actual amount of bush pulling done in mature stands during any one year since 1933 has been determined by priorities and expediency. From 1933 to 1936, when large numbers of workers were available to the project under emergency relief programs, there was less need and less opportunity to be selective. Four-tenths of the area covered in these peak years bore mature timber. H. E. Swanson of the Blister Rust Control Office points out that limitations of the relief program with reference to the size and location of camps resulted in more mature timber being worked than otherwise would have been the case (43). The CCC camps were cumbersome, and the work had to be tailored to fit the camps rather than the reverse. WPA camps had a low limitation of $6.00 per man-month for non-labor expenditures, which likewise reduced the chance to pick and choose areas.

Since 1936 there has been much less manpower available and it has been necessary, as is shown in figure 3, to concentrate in the young stands where the disease problem is more critical and more urgent.

A SHRINKING PROGRAM

We left the discussion of the trend in size of the blister rust control program with the year 1934. This was the all-time high point. How much of a high point it was is shown in figure 4. In 1935 and 1936 the program still was large by previous and present standards. Since 1936 the available manpower has been much smaller, and at present we are back where we were in 1931 and 1932. During 1946 the area covered by blister rust crews in the Inland Empire was only 8 percent of the acreage covered in 1934.

The most significant point about the decline which has occurred since 1934 is that it has borne absolutely no relation to the need for blister rust control. The original objective was to control blister rust in the Inland Empire. The shrinkage in funds which began in 1937 did not indicate that this objective was accomplished -- or even nearly so. As was pointed out earlier, something like two-thirds of the area protected needs to be covered two or more times to reduce the ribes population to a tolerable level.

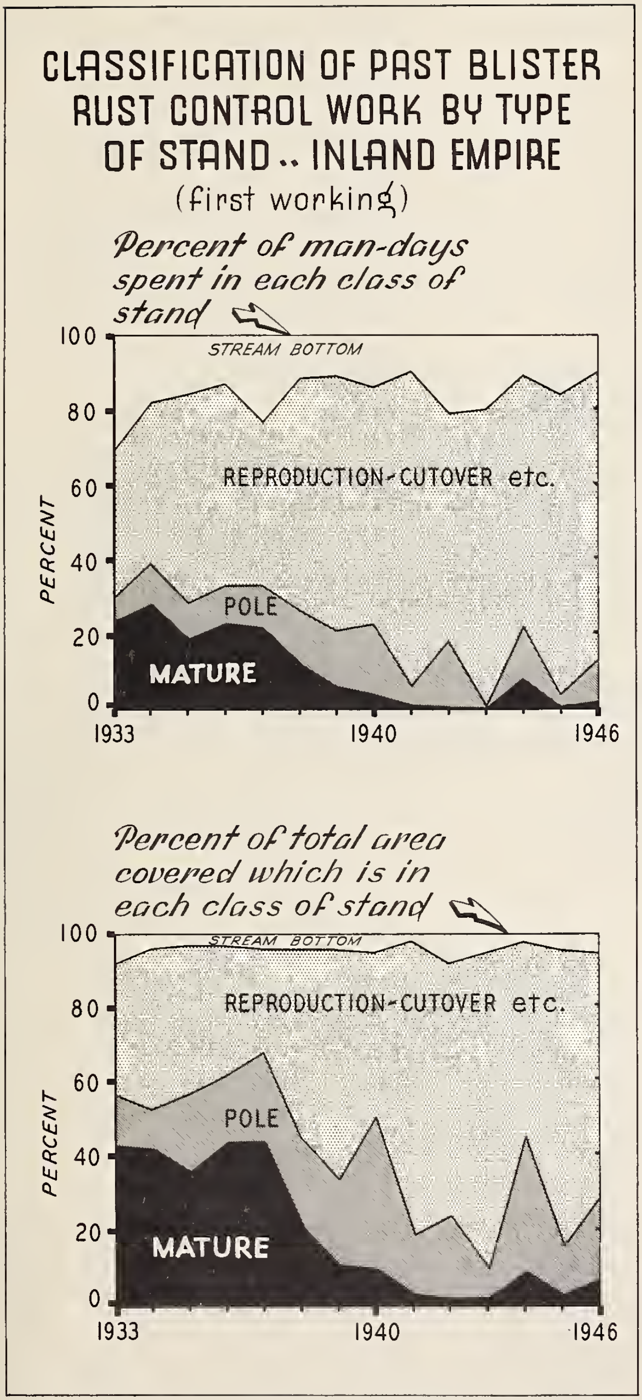

Figure 3.

Inasmuch as workings to be effective should be spaced at 3 or 4-year intervals, it was not possible to do much follow-up work prior to 1936. By the end of that year, therefore, only 5 percent of the area covered once had received a second working. What it amounts to is that up through 1936, a large investment had been made in blister rust control on 1.6 million acres, but the job had been finished on but a relatively small part of that area. This raised a new problem. The money already spent on first workings would pay off only if follow-up work was completed in time to prevent serious damage in subsequent wave years. Since 1936, therefore, an increasing proportion of the total manpower has been used in second and third workings. Even so, reduced funds have made it impossible to do the necessary follow-up work on more than a small portion of the total area which has received a first working.

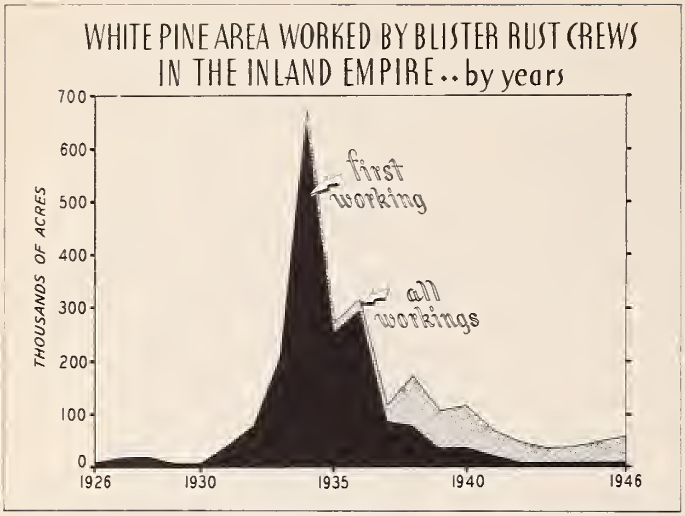

Figure 4.

WHOSE PROGRAM?

About half of the white pine type in the Inland Empire is owned by private individuals, companies, the counties and the states. The other half is owned by the federal government. However, 95 percent of the blister rust control bill has been paid by the federal government.

Up through 1946, a total of 17.3 million dollars was spent on control in the Inland Empire. These funds came from the sources indicated in the following tabulation:

Cost of Blister Rust Control
In The Inland Empire Through 1946

Federal Funds:	Regular	$ 8,900,000
	Emergency	7,600,000
	Subtotal	16,500,000
State Funds		200,000
Private Funds		200,000
State and Private Indirect Aid		400,000
	Subtotal	800,000
	TOTAL	$17,300,000

The item "emergency funds" in this tabulation includes 699,000 man-days of Civilian Conservation Corps work, valued at $1.50 per man-day. Though the rate seems low, blister rust control men point out that it is probably a fair average value considering the quality and limitations of CCC work. Moreover, $1.50 is the rate commonly used in evaluating the work done by this program.

Although the blister rust control load has been mainly carried by public agencies, much of the money has been spent

on private lands. Fifty-four percent of the private land in the control area has had some work done on it compared with 66 percent of the state land and 75 percent of the national forest land.

During the years 1933 to 1936 the work done on private and state lands was more or less in proportion to their acreage in the control area. However, since then work on these lands has fallen further behind than on the national forests. In 1936, for example, 36 percent of area worked was on private property, as compared with 18 percent in 1945 and 26 percent in 1946. (See figure 5.)

WHY WE ARE NOT FURTHER ALONG WITH CONTROL

During the first ten years the blister rust control job was definitely underestimated. However, any over-optimism, which may have prevailed earlier, had by 1934 given way to a much better idea of what we were up against. During 1934 the Bureau of Entomology and Plant Quarantine called for a complete reappraisal of the project. It was estimated then that, including the work already done, a total of 23.8 million man-hours of ribes pulling would be required to put control on a maintenance basis on the 2.7 million-acre control area. The plan called for completing the work in the nine-year period 1935 to 1943 (32). In table 1 is a comparison of this plan and actual performance through 1946.

The following discussion from the plan indicates the scope of the 1934 estimates:

> "The final objective of each program is, as will be noticed, to place the entire acreage of control area upon a maintenance basis. A continued program of the scale of that in 1934 in the Inland Empire will complete the initial workings in three years. Thereafter, the number of man-days necessary to complete the subsequent workings will suddenly decrease until the irreducible minimum necessary for maintenance is reached. It must be recognized that due to logging operations and forest fires, there will be a certain relatively small acreage each year taken out of the condition in which it happens to be at the moment and placed in Type I '(newly disturbed or denuded areas representing conditions favorable to the appearance and persistence of ribes.)' This acreage will, however, be relatively quite small and since its exact extent cannot be known in advance, it is

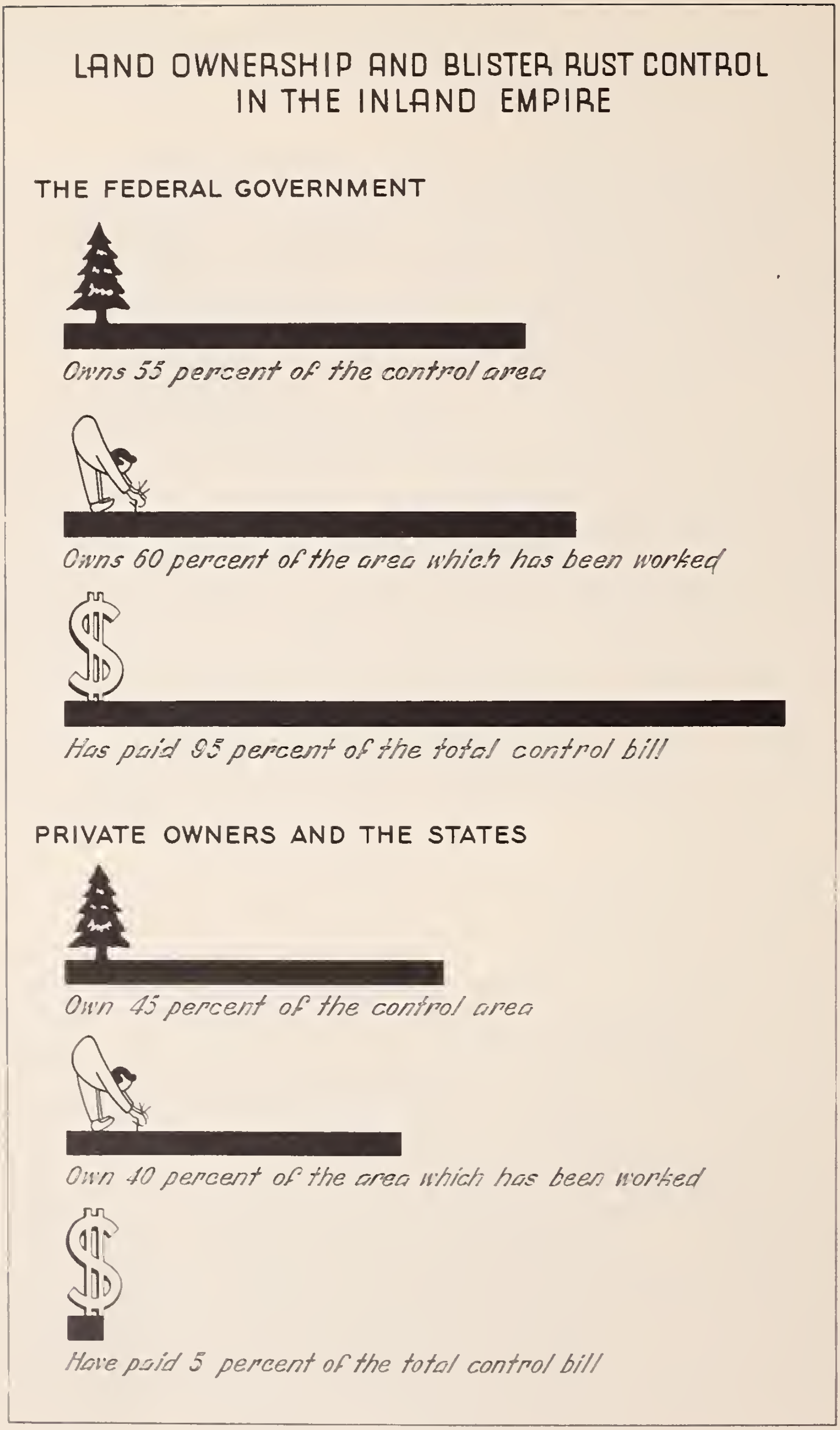
LAND OWNERSHIP AND BLISTER RUST CONTROL IN THE INLAND EMPIRE
THE FEDERAL GOVERNMENT
Owns 55 percent of the control area
Owns 60 percent of the area which has been worked
Has paid 95 percent of the total control bill
PRIVATE OWNERS AND THE STATES
Own 45 percent of the control area
Own 40 percent of the area which has been worked
Have paid 5 percent of the total control bill

Figure 5.

Table 1. Ribes Eradication Performance in the Inland Empire Through 1946 Compared with Estimates in 1934

	Work Done Through 1934	1934 Estimate of work to put total area on maintenance basis (including previous work)	Work Done Through 1946 Total	Work Done Through 1946 Percent of 1934 Estimate
First Working				
Acres	1,068,548	2,710,129	1,937,625	71
Man-hours	5,982,032	15,073,392	12,649,864	84
Second Working				
Acres	44,558	1,868,569	441,611	24
Man-hours	326,704	5,468,752	3,708,592	68
Third Working				
Acres	2,366	1,868,569	115,693	6
Man-hours	29,120	3,210,240	1,192,312	37
All Workings				
Acres	1,115,472	6,447,267	2,494,929	39
Man-hours	6,337,856	23,752,384	17,550,768	74

not included in this program. Under the terms of the program here set up, it is noted that the entire commercial white pine area of the Inland Empire would be placed upon a maintenance basis in 1943."

In considering the 1934 plan and subsequent performance, three facts are very important. In the first place, funds have not been available to follow the schedule proposed. Only one-fourth of the acres of work set up for the period 1935 to 1943 was actually done through 1946. (Figure 6.) In the second place, the size of the control job on the cutover areas was badly misjudged. The cutover and burned area treated so casually in the above statement has turned out to be the big problem in control today. Thirdly, the job involved in second and third workings was underestimated. Sixty-eight percent of the man-hours set up for second working had been expended through 1946, but only 24 percent of the area had been covered. Only 6 percent of the area requiring third working had been covered, as compared with an expenditure of 37 percent of the estimated man-hours.6/

That we have not been able to accomplish as much as was anticipated in 1934 has been partly due to certain handicaps which have prevented the most effective functioning of the program.

Worker Output Has Been Below Expectations

Early estimates of accomplishment were based on the performance of picked crews. Although the program was going strong in 1934, there is a question whether a big enough discount was made even then for the poor quality of some of the labor used.

Figure 7 shows that the control program has operated pretty much on a catch-as-catch can basis so far as labor supply is concerned. The work has been done at different times by CCC boys, WPA workers, Italian internees, German internees, Mexicans, and high school students in addition to regular

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6/ We cannot take these figures as an indication of actual progress because to the extent that the areas worked in the past were more or less difficult than the ones yet to be worked, the job is at a different stage of completion than the figures of acreage covered would suggest. The present status of the project will be discussed later, based on data compiled in connection with this study.

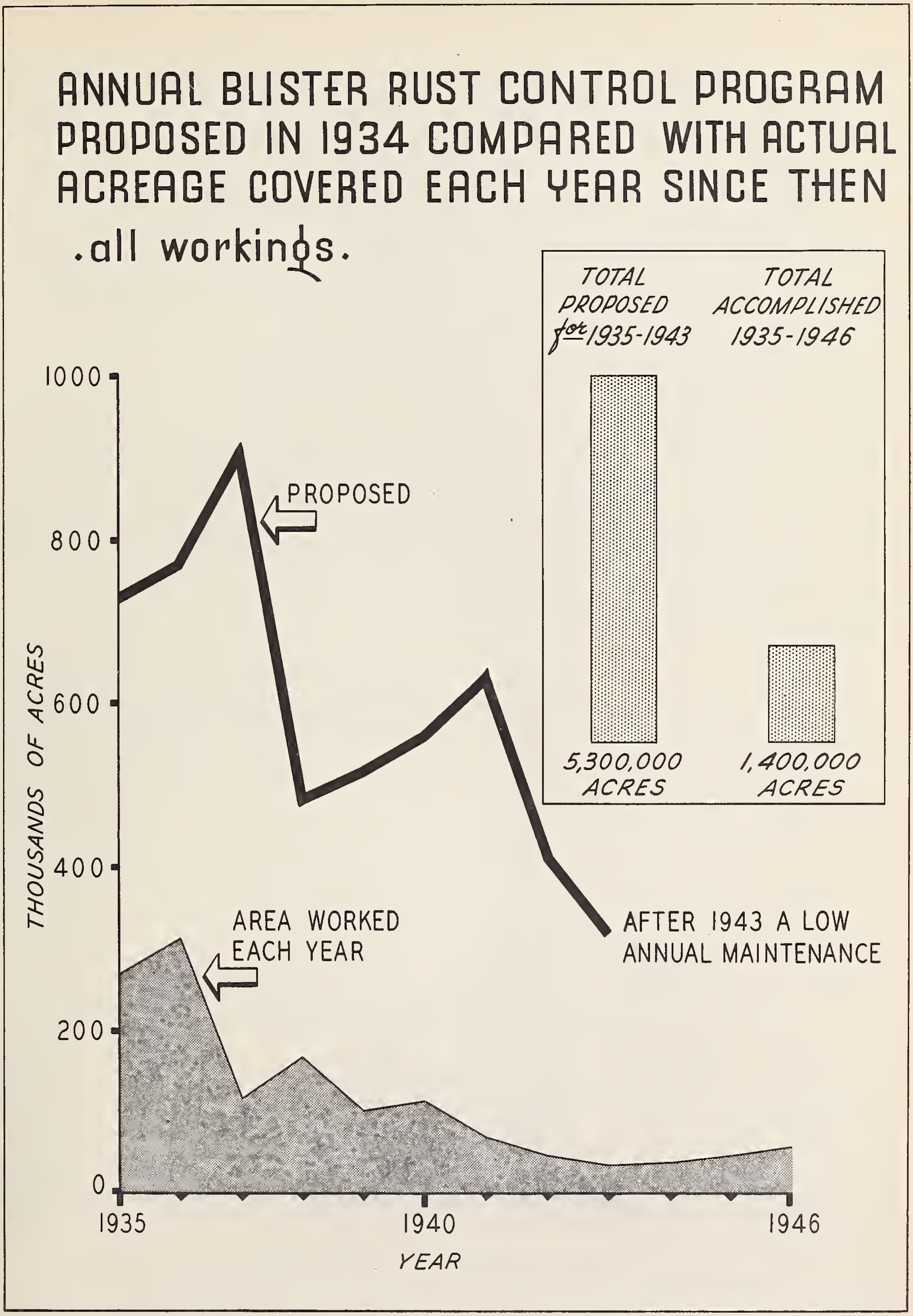
ANNUAL BLISTER RUST CONTROL PROGRAM PROPOSED IN 1934 COMPARED WITH ACTUAL ACREAGE COVERED EACH YEAR SINCE THEN
.all workings.
TOTAL PROPOSED for 1935-1943
TOTAL ACCOMPLISHED 1935-1946
5,300,000 ACRES
1,400,000 ACRES
PROPOSED
AREA WORKED EACH YEAR
AFTER 1943 A LOW ANNUAL MAINTENANCE
THOUSANDS OF ACRES
1000
800
600
400
200
0
1935
1940
1946
YEAR

Figure 6.

types of labor. Obviously, there has been little chance for handpicking from these labor sources. The result is that the project has been getting less than 60-minute hours from much of its manpower, both from the standpoint of quality and quantity of work done. Many man-hours were spent by the Civilian Conservation Corps in pulling ribes bushes, but some supervisors discount very heavily the work done by those boys, because of plants broken off and plant missed. This group is not the only one which has fallen down. For example, productivity of the high school boys used during the recent war was not very satisfactory.

Use of Blister Rust Crews for Fire Fighting

The use of blister rust crews for fire fighting has been another serious drain on the blister rust control effort. If the plan is to grow white pine, we cannot say fire control is more important than blister rust control or vice versa. But as of any particular hour, day, or week in the hot summer weather, fire fighting often is the most important considera-

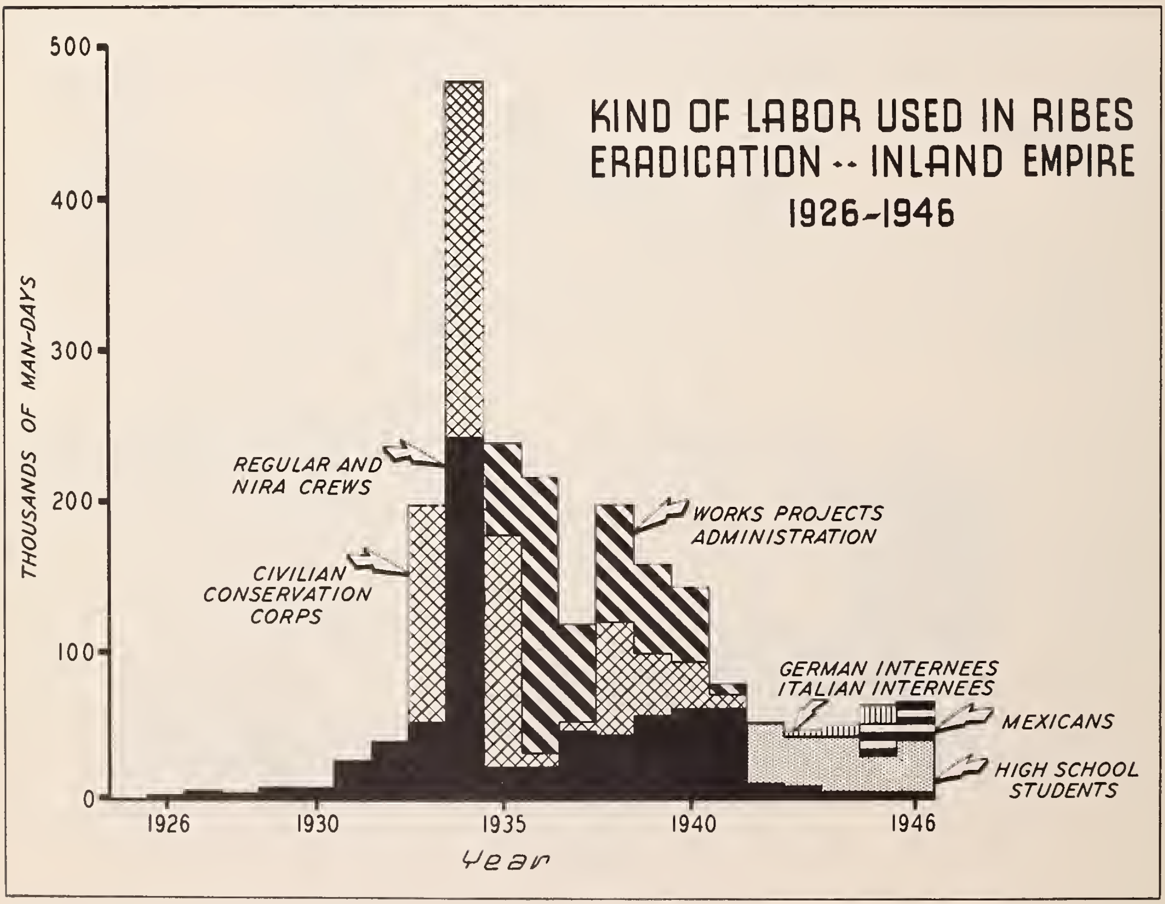

Figure 7.

tion. Blister rust control camps, being the largest single reservoir of manpower during recent years, have been called on heavily in times of fire emergency. Necessary though such action may be, it has added considerably to the cost of blister rust control. Time spent by blister rust workers on the fire line and certain other direct costs are paid for out of fire suppression money, but indirect costs are not. The latter includes lowered productivity of workers following fire fighting duty, less working time per unit of training time, the necessity for constructing a camp at a particular location during two successive years to do one season's work, and other such items. G. M. DeJarnette, in charge of blister rust control on the national forests, has calculated that due to these items, the output of blister rust workers on the national forests was reduced 30 percent in 1945 7/ (10).

Man-day Costs Have Increased

Rising man-day costs have been gobbling up blister rust control funds. A 1946 dollar would buy about one-third as much work as a 1939 or 1940 dollar, as figure 8 shows. Man-day costs for all camps rose from $6.60 in 1926 to $7.70 in 1936 to $21.00 in 1946. 8/

Higher wages and more expensive supplies have, of course, been a big reason for the rise in man-day costs -- but by no means the only one. Figure 9 shows, in a general way, what happened. The statistics in this chart are taken from an analysis by D. J. Moore of 1938 and 1946 blister rust control costs on the St. Joe National Forest (24). This analysis indicates that although the daily wage of the average worker didn't quite double in this period, his income per day of work was really two and one-half times greater in 1946 than in 1938 due to improvement in his working conditions. (See table 2.) In other words, in

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7/ DeJarnette estimates that the effective time lost for this reason by camps operated by the Blister Rust Office is around 20%.

8/ These are not direct labor charges but the total costs of blister rust control (with minor exceptions) divided by the man-days spent by the men actually pulling ribes bushes. Man-day costs in camps supervised by the Office of Blister Rust Control have run lower than national forest operations. For example, in 1946 the Office of Blister Rust Control cost was $18.44 per effective man-day as compared with the $22.69 national forest man-day. Presumably, some of the difference is due to the greater drain on national forest camps for fire fighting.

1938 he was paid only for the days he actually worked. Now he is hired by the month with no deduction for rainy days and he receives paid annual and sick leave. In 1938 many of the employees were experienced and were effective right from the start. In 1946 most of them were green hands. The average inexperienced worker requires eight to twelve days of training before he is fully productive. In one operation during 1946, 28 percent of the trainees quit during the training period.

What it amounts to is that during 1946 the average bush-puller was paid $7.30 per work day, but owing to annual leave, rainy days and training, he was actually paid $10.58 for each day he pulled bushes.

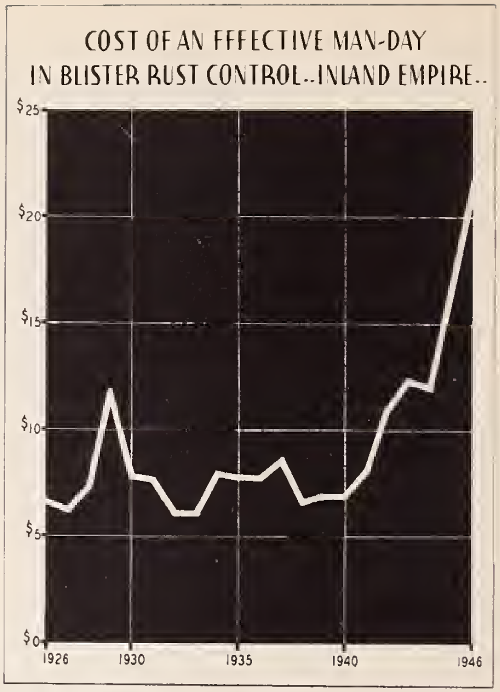

Figure 8.

Pulling of ribes bushes has proved practical only while they are in leaf. Unfortunately, that period is not very long -- about four months at the most, or roughly from May 15 to September 15. This means that at best the value must be extracted from camps and overhead services in a short period. Obviously, the fewer the days worked in that period, the greater will be the overhead cost per bush pulled. In 1946 camps on the St. Joe National Forest got in the equivalent of only seven full weeks of bush pulling. (Table 3.)

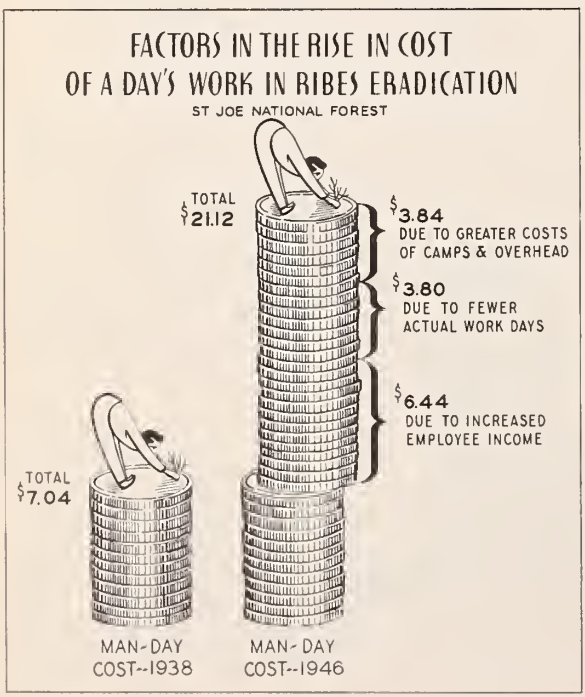

Figure 9.

Man-day costs have gone up also, because camps and facilitating services have become more expensive. For example, on the St. Joe National Forest the cost of constructing a camp was

Table 2. Direct Labor Costs of Blister Rust Control, St. Joe National Forest

	Cost per effective man-day of eight hours	
	1938	1946
Time actually worked	$4.133	$ 7.305
Rainy days	---	1.672
Annual leave and holidays	---	1.224
Non-effective work during training	---	0.375
TOTAL	$4.133	$10.576

Table 3. Average Number of Days Per Blister Rust Camp Per Season - 1938 and 1946 - St. Joe National Forest

	1938	1946
	- - - days - - -	
Lost due to rain	2	7
Spent in fire fighting	0	6
Ten half-Saturdays not worked	0	5
Wood cutting, road repair, etc.	2	3
Annual leave and holidays	0	5
Days actually worked on ribes pulling	64	37
TOTAL NUMBER OF DAYS	68	63

five times greater in 1946 than in 1938. This has been partly due to the increase in cost of materials and services but partly also because present camps are of much higher quality. No longer will a few pieces of canvas suffice. The 1946 camp would meet sanitation and comfort standards the 1938 camp would not, which is a very worthwhile and necessary improvement.

Two points deserve special attention. The first is the importance of a few work days lost. For example, because the 1946 season on the St. Joe National Forest was 5 days shorter than the 1938 season, every man-day spent in pulling ribes bushes in 1946 cost 61 cents more than it otherwise would have. Second is the fact that a number of the above items are not likely to grow smaller in years to come, with the result that man-day costs may never again be as low as in 1938.

Between May 15 and September 15 there are, in the average year, something like 85 possible work days not counting Saturdays. Theoretically, it should be possible to work 75 days in this period. If there had been 75 "pulling days" instead of 37 days on the St. Joe National Forest in 1946 for the same sized crew, the cost of an effective man-day would have been $15.75 instead of $21.12.

Fluctuation of Appropriations

Uncertainty and instability have added to the total cost. Like most forestry projects, blister rust control requires long-term planning and stability. Money spent in a first working may be largely lost if funds are not available at the proper time for second and third workings. Looking at the situation from that angle, we can say that either the control program from 1933 to 1936 was much too large or the program in the years following was much too small (12). At any rate, the mountain and valley trend of activity has been very wasteful. We can use the Marble Creek drainage on the St. Joe National Forest for an example. This basin is made up of six minor drainages: Norton, Bussel, Bear, Lines, Toles, and Marble Creeks. Blister rust crews first combed the area for ribes bushes in 1934, and proper scheduling would have called for a reworking three or four years later and a third working in another three or four years. However, these workings were delayed because other localities seemed in more urgent need of attention, and there was not enough money to do all the work necessary in all areas. Although the stream bottoms were worked in 1938, the rest of the basin did not receive its second

visit until 1939, and the main mop-up work was done in 1944 and 1945. A disease survey in 1946 showed the following percentage of the trees infected:

Norton Creek	70%
Bussel Creek	53%
Bear Creek	43%
Lines Creek	57%
Toles Creek	71%
Marble Creek	40%

Enough money was spent on these areas, but the timing was such that a large part of the value of the work was lost insofar as the present crop is concerned. Unfortunately, perfect timing is partly a matter of luck. Success in control depends, to a certain extent, upon how well the disease is established when work is started and the frequency of wave years. This element of chance does not diminish the importance of prompt working at the planned intervals. The breakdown of the program in this respect has greatly increased the losses.

As compared with the "king-size" public works program during the early 1930's, blister rust control appropriations for the Inland Empire have been of the relatively modest size of about one million dollars annually during the period 1944 to 1946. It is very apparent that work done in the last decade has been far short of the amount needed to fulfill the commitment made by the large program from 1933 to 1936. Because of the lack of adequate follow-up, the value of some past work has been completely lost. In other instances the past work will buy less pine than it would if the follow-up had been adequate.

Lack of Coordination

In 1928 E. E. Hubert pointed out....."that much may be accomplished by methods of forest management which discourage the development and establishment of wild ribes in the white pine stands of the future" (14). Hubert's statement is significant, for in it he put his finger on one of the most important facts in blister rust control. Blister rust control will be too expensive on many cutover areas; it will be impractical as a permanent venture with present methods of control, unless ribes eradication is made a coordinated part of forest management and forest management measures are used to reduce the job of eradication.

That fact is very plain now, but it took almost two decades for the idea to take hold. Blister rust has, in general,

been regarded as something quite independent from timber growing. Thousands of acres have been cut, and some have been planted to white pine without any particular thought of blister rust or ribes bushes. The unsatisfactory condition of cutover areas has made it constantly more apparent, however, that blister rust control is not a "lone wolf" job. In many instances ribes bushes have come in by the hundreds and thousands following cutting, making the control job almost impossible.

To meet this problem the Forest Service is now undertaking to use silvicultural means to reduce the number of ribes on national forest lands. In some cases the answer seems to be to burn over the areas once or twice following cutting. Elsewhere, modification of cutting methods appears the solution. This progress has largely been the result of research in the last decade (2) (9) (38) (49) (50) (51). Particular attention has been given to the matter of partial cutting methods which remove the sawtimber stand in two or more steps. Investigations by Virgil Moss of the Spokane Blister Rust Control Office indicate that temperature and moisture changes created by the right degree of partial cutting are sufficient to kill some of the ribes seeds stored in the duff and to induce others to sprout. Under the shade which would remain, many of the seeds which do develop into plants would subsequently die out. Once the seed supply in the forest floor has been depleted in such a manner, the rest of the sawtimber could be removed and a new white pine stand established. Supposedly, the expense of ribes pulling after that would be much less, as a consequence of the control by cutting method (25) (26).

WHERE DO WE STAND?

All of this brings us around to the question, where do we stand with respect to blister rust control? What have we accomplished?

Several sorts of statistics are available to show, in different terms, the progress made. Annually compiled figures on acreage worked show that 67 percent of the 2.6 million acres set up for control have been worked at least once. However, these data and other similar data give no idea of the magnitude of the job done as compared to the job to be done; nor do we learn much more from the fact that about 600,000 acres are on a maintenance basis. The problem is well stated in the following quotation:

> "We can measure the performance, that is the effect of the application of effort. We can measure the miles of beat patrolled, the number of criminals apprehended, the number of finger-prints taken. But units such as these, however useful they may be, are not entirely adequate for our purposes. They tell us how much work has been done; but they do not tell how well it was done, nor whether the particular work undertaken was appropriate to the desired end.
>
> "A measurement of the result of an effort or performance indicates the effect of that effort or performance in accomplishing its objective....."

The preceding quotation, taken from a study of municipal activities by Ridley and Simon, presents a problem which confronts the administrators of many types of public work -- that of measuring the result in terms of the ultimate objective (39). If anything, it is more than normally difficult in the case of blister rust control because the worker pulling a ribes bush does not immediately affect white pine yields. It is the very fact, however, that the reaction is involved and delayed which makes it doubly imperative to develop statistical evidence of the accomplishments of blister rust control. The 1928 and 1934 blister rust control plans were steps in that direction. A more recent estimate by the Office of Blister Rust Control certainly is on the right track. That office now estimates that by spending an additional 15 million dollars, protection can be completed on 700,000 acres of the cream of the present young stands, which would, as a result, produce 7 billion board feet more of white pine than would be obtained otherwise.

A large part of the effort in this study has been directed, of course, to estimating how much white pine would be obtained under various circumstances and what that white pine would cost. These estimates will be presented in following chapters. We might mention at this point, though, that if any substantial area is to be protected and white pine made a perpetual crop, it will be necessary to spend much more money for blister rust control in the future than has been spent already. The average cost of eradicating ribes bushes, at one time estimated in cents per thousand board feet, must now be measured in dollars.

SEVERAL POINTS TO STRESS

After reviewing the past struggle with the disease we can draw five important conclusions relating to the job ahead:

1. <u>The Disease is as Bad as They Said It Was</u>

We are told by blister rust control men that there are few unworked young white pine stands which have not been heavily damaged by the rust. If anything, we have less leeway with control than was first believed. Some bushes are so situated in the work areas that they probably will not do much harm, and some small amount of pine infection can be tolerated. Moreover, some older stands may not be worked at all because the course of disease development in these stands indicates that the losses will not be large. However, the disease is so virulent that if white pine is to be grown on any area on a permanent basis it is necessary to eliminate virtually all of the ribes bushes on that area (22).

2. <u>Control is Possible</u>

The success of blister rust control is a hard thing to judge correctly by casual observation. This places a very heavy responsibility upon control agencies to show their accomplishments clearly. This has not been done to the extent desirable. Far more information is needed relating the amount of infection and the pine saved to the work done. A big step in that direction was taken in 1948 when 1000 miles of disease survey were run to determine the results of eradication in terms of future white pine yields.

That better proof of accomplishments is needed does not mean that there is any serious question about the possibility of control. Pathological research leaves no doubt that if all ribes bushes within infecting range of any group of pines can be eradicated, the spread of the disease will be arrested in that area (11) (22) (40). That control by ribes removal can be applied successfully in the Inland Empire has been shown by a quarter century of experience. Mielke states "That the rate of spread and intensification there (the Inland Empire) is being slowed up annually, however, is without question. This is being brought about mainly by the destruction of ribes in control operations that have been in progress since 1924" (22). An analysis of 300 drainages plus the review of other pertinent data leads us (the authors) to conclude very definitely that control is physically possible. Preliminary results from the above-mentioned 1948 disease survey bolster us in that conclusion. Calculations which will be discussed later indicate that

several billion board feet of potential sawtimber have been saved by past blister rust control work. Men qualified to judge point out that "properly protected" stands came through the bad 1937 and 1941 wave years with little or no damage. Control standards have been tightened to the point where there seems to be little possibility of undue loss of pine if the work is done when needed, in the amounts needed, and to the standards set. Nevertheless, it appears that, because of the problems involved, blister rust control will be expensive as long as hand pulling methods are used. Whether it will be too expensive depends on the values involved. That subject will be discussed later. We can say here, however, that blister rust control is not practical on all areas, but it is practical if the areas to be protected are carefully selected.

This is perhaps the place to inject the thought that the presence of disease on any area does not, per se, indicate the failure of control efforts. The amount of infection, the type of stand, and the possibility of renewed infection all must be considered. Actually, it is possible to salvage some stands where the disease is well established. Fortier Creek on the Coeur d'Alene National Forest is a case in point. A disease survey in 1940 showed that half of the trees in the 40 to 60-year old stands in this basin were infected. A first working was undertaken in 1941, and the ribes bushes were mostly removed before the wave of that year struck. Some trees were killed by the disease, but many limb cankers died out before reaching the trunks where they could do serious damage. An inspection in 1946 indicated that a good white pine stand still remained and that the infection on the remaining stand was probably not more than 10 or 15 percent.

3. <u>Cheaper Methods Are Urgently Needed</u>

Bulldozers and chemical sprays have been used to speed up ribes eradication in the stream bottoms. Progress has been made in the more efficient use of the crews doing the huge hand pulling job. The fact remains, however, that even today blister rust control has two strikes against it because most of the bushes must be removed the slow, hard, expensive way. Recent research, however, gives us hope of cheaper methods (5) (34).

One of the most dramatic examples of streamlined control was the Tussock Moth Control Project in 1947. This

insect, well established over an area of 413,000 acres in Northern Idaho, was threatening to cause enormous loss. In a period of 42 days eleven airplanes blanketed the area with D.D.T., destroyed virtually every one of 500 trillion moths, and eliminated the threat of damage at a cost of approximately $1.57 per acre. The Tussock Moth Project in that period cost $651,000, approximately half the amount spent for blister rust control in the Inland Empire during 1946. For half as much money, the moth control project covered seven times as much area.

The key to streamlined blister rust control appears to lie in the development of cheap sprays which will kill all of the ribes bushes but not the pine. A hormone spray is already available, which tests in 1948 indicate will do just that. The extent to which this spray will lower costs will be learned in the next few years. The challenge, of course, is to develop both the sprays and the methods which will permit a drastic reduction of costs and manpower. The Office of Blister Rust Control and the Forest Service are working on this problem. If they are completely successful, our concepts of speed, manpower requirements, and costs may be considerably changed. The fact that so much depends on this search for better and more effective control methods, makes it imperative that the funds for the research be adequate. Everything considered, the size of the research program on methods of control does not appear to have been adequate. If that is so, we are being penny-wise and pound-foolish.

4. Other Research Has Lagged

Probably more study has been made of white pine blister rust than any other forest disease, and a wealth of fundamental information is available. Yet, we are told by the leaders of control work that there are many gaps in their knowledge. Effective blister rust control involves proper correlation of pathological facts with environmental, topographic, and climatic conditions. We have, however, been grappling with the disease without a full understanding of these relationships. Experience has taught many things, of course, but it has been a slow teacher. For example, as mentioned earlier, it has taken a quarter of a century to get around to correlating silviculture with blister rust control. As we look back, it appears that research on the ecology of the rust has been inadequate, and

this inadequacy has probably both added to the cost and detracted from the effectiveness of past work. Failure to nail down all the facts with a bigger research effort in the future could very easily pile up future control costs higher than necessary.

5. <u>It is Not Enough to Control Blister Rust</u>

The job of growing white pine is much bigger than just conquering this disease. There are other things to be done. Unless we do them, we run the risk of wasting much of the money spent in blister rust control. There is little sense in saving a man from drowning and then choking him to death. Nevertheless, that, figuratively speaking, is what has been happening to white pine in the Inland Empire.

Future crops of white pine depend not alone upon blister rust control but also upon having sufficiently well stocked stands of white pine to make ribes eradication worthwhile. Yet, white pine is not succeeded by white pine on much land. The percentage of white pine in many new stands is low. In some instances the cause is destructive cutting. In some it is economic high grading which selects out the white pine. In any case, the too common failure to leave an adequate seed source and to otherwise prepare for a new crop is reducing future white pine yields just as effectively as could blister rust. Forest survey figures for Benewah County, Idaho, provide dramatic proof of what is happening. The forests of this county were surveyed in 1933 and again in 1944. Between these two years, the area of white pine stands decreased from 159,000 acres to 52,000 acres. The decline of the white pine type probably has not been so drastic over the Inland Empire as a whole. The type is shrinking, however, and the trend is one of major significance. Moreover, it gives us something to think about in deciding how much blister rust control for tomorrow.

One might fairly ask what are the chances of getting sufficiently good management on the white pine land? So far as national forest lands are concerned -- and that is the area with which we are primarily concerned in this study -- the chances are good. This study in itself is evidence that the Forest Service desires to do what is necessary to grow the pine on some scale, if protection is practicable. Recent marking instructions, prepared by the Experiment Station and adopted

by the Forest Service, are designed to get more white pine and to reduce the job of blister rust control (49). National forest management has, however, in the past been a compromise between what should be done and the money available. If we plan for any amount of blister rust control in the future, we should also plan and seek the money for the adequate white pine management which should go along with it.

II. THE NATIONAL NEED

FOR THE INLAND EMPIRE'S WHITE PINE

Anyone who considers the natural resource situation of the United States from the long-time view of what these resources mean in the way of future security and prosperity cannot escape the realization that times are changing. We have reached the point when we must think about extracting some of our oil from shale instead of from underground pools; when we must search for ways to offset the approaching exhaustion of the high grade Minnesota iron ore; when the known reserves of 21 of 33 minerals are sufficient to last less than 35 years (35). These startling facts make it plain that we must begin using our exhaustible resources without waste.

Dwindling mineral reserves also emphasize the urgent necessity of building up and maintaining the renewable resources in a highly productive state. In the case of the forests, the urgency is sharpened because the timber supply situation is far from satisfactory. The recent series of "Reappraisal" reports by the Forest Service should leave no doubt that we have a problem of depletion on our hands (48). One of the reports points out, "Heretofore, the Nation's peacetime demand for timber products has been met, rather easily, by reason of the large supply of virgin timber which this country possessed. That era is closed. The time has come when timber growing, in contrast to timber exploitation, must be undertaken on a Nation-wide scale."

Forest Service figures show that the timber stands of the United States are growing at the rate of 35 billion board feet annually, and that cutting and losses are subtracting 54 billion. These figures alone suggest that the situation is not satisfactory, and if we look further into the subject this is even more apparent. Taking into account the fact that our population is still growing, our changing habits of wood use, the critical shortage of adequate housing, and other items, the Forest Service has estimated that we should plan to grow 72 billion board feet of sawtimber annually. In other words, a careful appraisal of the situation indicates that a strong, healthy United States, secure in times of war and prosperous in times of peace, has need for twice as much sawtimber as the forests are now growing. This goal is a challenge to forestry in every region, for it cannot be reached unless a large proportion of the timber area is producing at a high level. Thus, we can say that

the national wood supply situation indicates the need for a large timber output from the Inland Empire.

Although the facts indicate that the Inland Empire forests should be kept fully productive, the question about white pine is still only partly answered. The issue still to be decided is whether the Nation as a whole would gain by growing white pine in the Inland Empire in place of other species of lower quality.

THE CASE FOR WHITE PINE

Western white pine has always been held in high esteem by the carpenter, pattern maker, and manufacturer. The qualities which account for that fact are enumerated in a recent bulletin by the Forest Products Laboratory (46):

> "Western White Pine is straight grained, easy to work, easily kiln dried, and stays in place well after seasoning. The wood is moderately light in weight, weak, moderately stiff, moderately soft, moderately low in ability to resist shock and has a moderately large shrinkage............western white pine ranks high in ability to hold paint and can be glued readily. It does not split easily in nailing and occupies an intermediate position in nailholding ability. In decay resistance it is also rated as intermediate........Western white pine like eastern white pine can be satisfactorily used for nearly every part of a house because of the ease with which it can be cut and shaped with tools, its ability to stay in place, take and hold paint and enamel, and its nailing properties.....As a box wood western white pine, like eastern white pine, is highly satisfactory because of its light weight, light color, nailing properties, freedom from odor, and ease of working."

We may expect the white pine we grow tomorrow to have very much the same attributes as the virgin pine being cut today. That is more than can be said of some other species. For example, the clear, fine-grained Douglas-fir on the Coast is as day is to night in comparison with the knotty, coarse-grain, second-growth tree of that species. If we grow 120-year old white pine timber in the future, it will be younger timber than the virgin stands on the average. For that reason it will have more knots, but between the knots the wood will not differ much from what we have been cutting in the past.

Although western white pine is a quality tree, its grade recovery has been notably low. In 1940 only 11 percent of the lumber cut was of the grade D-select and better, and 44 percent was #2 common and better. These figures are quite representative. They say, in plain English, that about one-tenth of the cut has been in high quality boards and planks and more than half has been in the low grades. Small white pine sawtimber, with its sounder knots and small amount of cull, produces, on the average, about 70 percent #2 common and better lumber, which compensates in part for the low percentage of clear grades. There is, as a result, a smaller spread between the value per board foot of large and small trees than in most species. A study by E. F. Rapraeger (37) of a fairly young white pine stand, including white pines from 10 to 30 inches in diameter, shows the peak of lumber value per thousand board feet to be in trees of about the 18 to 22-inch diameter class. However, these peak values were only 5 or 6 dollars greater than the values of the smallest sawtimber trees.

These facts suggest that we do not face any serious value decline insofar as white pine is concerned. In fact, the timber in years to come can be of better quality than is now being logged. In calculations in a later section, a 120-year rotation is used. Because of persistence of branches on white pine, that is not a long enough period in which to grow much clear wood under natural conditions. However, if extensive pruning operations prove to be practical, we can grow pines with a higher percentage of select lumber and fewer low-grade boards than in present virgin timber.

Consumption Trends

The history of the white pines of the United States from one point of view lends little encouragement to the belief that these species are indispensable, even though they have special qualities. These pines have provided a highly valued component of the lumber cut. However, the country has been able to operate without any visible reduction of efficiency in spite of the fact that the white pine lumber output has headed downward.

When the first settlers came to this continent, the forests bore a tremendous volume of white pine, and the eastern white pine forests were the first of several great virgin timber stands to be drawn upon in the development of this country (21). White pine was a major building material in the Northeast, Central, Lake, and Prairie States. At one

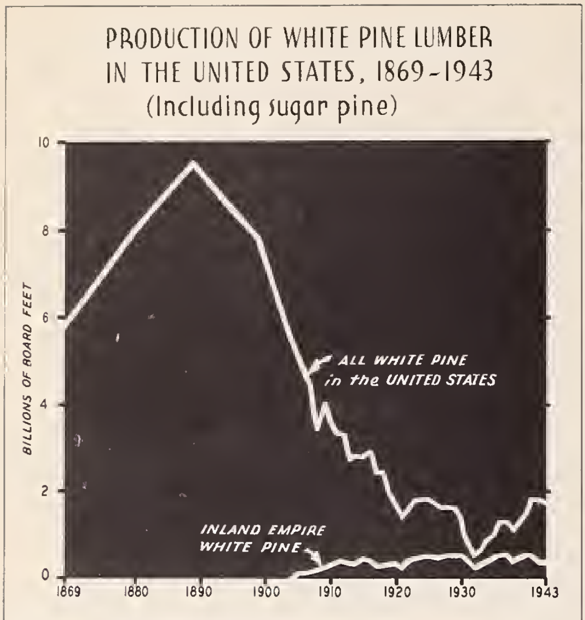

Figure 10.

time half of the lumber produced in the United States was northern white pine. In 1889 production of this pine had risen to an all-time peak of 9½ billion board feet -- an annual peak since exceeded only by the southern pines as a group. As the eastern supply ran low, production of white pine lumber in the United States declined, rapidly at first and later at a slower pace. Western resources of white pine and sugar pine have been inadequate to maintain anything like the rate of cutting of former years. During the decade 1934 to 1943 the average annual lumber production of the three white pines was 1.4 billion board feet. One-third was sawed in the Inland Empire. As figure 10 shows, if white pine were indispensable, we would be feeling a terrible pinch today.

White pine is particularly suited for mill work. Some years ago a white pine door, almost as old as the first pilgrim settlement, was exhibited. Out of such beginnings grew a national sash and door industry mainly dependent upon this species which also appears to have been the principal softwood used in other types of manufacture. Yet, less than 10 percent of the lumber used for sash and doors today is white pine. A special census in 1940 revealed that out of a total of 6.7 billion board feet of softwood lumber used in all types of manufacturing during that year, only 922 million board feet, or 14 percent, were white pine (45). Only in connection with wooden matches and patterns and flasks do western white pine, northern white pine, and sugar pine represent more than a small part of the wood used today for manufacturing purposes.

Importance of Soft Pines

There is another way to look at the situation, however. If the white pines cannot earn the distinction of indispensability, neither can any other tree. For that matter, few of our natural resources can qualify when considered individually. Carrying that thought a bit farther, we can conclude

there are certain dangers in too literal interpretation of the preceding facts. Individually dispensable, our natural resources are collectively very indispensable. Any line of thinking which excuses the failure to take constructive action because we can "get along without," ignores the fact that a major element of this country's past strength and security has come from both abundance and diversity of resources.

No people in the world have ever been more richly endowed with timber than have we Americans. The factors which have made this heritage so valuable are, first of all, an almost unbelievable abundance, and second, a wide variety. We have had the structural qualities of the South's long-leaf pine and the West Coast's Douglas-fir, the general utility of the hard pines, the strength and density of our oaks, the great beauty of the wood of many other broadleaf species, the workability of the soft pines, and so on. We have had, in short, a well-balanced team with a wood for almost every purpose. Not the least member of this team has been the soft pines, of which the principal species are the three main white pines (northern white, western white, and sugar) and ponderosa pine. Ponderosa pine belongs on this team because it is actually used for many of the same purposes as the white pines, although it is technically classed outside the soft pine group. The advantage of the United States in respect to variety is emphasized by a comparison with other countries. Australia, for example, has a substantial quantity of broadleaf species but little coniferous timber, so has been a heavy importer and planter of the latter.

Considering western white pine as one of the group of soft pines, we get a somewhat different view of the situation than if we take it alone. These soft pines, even today, make up a sizeable proportion of the total lumber cut. The following figures for 1943 9/ show one-sixth of the lumber production in that year was of these species:

9/ The latest national lumber production figures available by species.

Lumber Cut ---- 1943

	Billion Board Feet
Northern White Pine	1.0
Western White Pine	0.4
Sugar Pine	0.3
Ponderosa Pine	3.9
Total of Above Soft Pines	5.6
TOTAL OF ALL SPECIES	34.3

Ponderosa pine has, to a large degree, taken the place of northern white pine as the supply of that species has declined.

The soft pines, as a group, rank even higher from the standpoint of manufacturing use. According to the previously mentioned 1940 census, one-fourth of all the lumber and one-half of all the coniferous lumber used in manufacture is soft pine. Table 4 is taken from this census of wood use.

Table 4. Lumber Used in Manufacture, United States - 1940

	Boxes and Crates	Patterns and Flasks	Sash and Doors	Matches	All Products
	- - - - Million Board Feet - - - - -				
Western White Pine	29	6	33	74	152
Sugar Pine	40	21	90	--	160
Northern White Pine	500	36	20	--	609
Ponderosa Pine	1,110	2	852	--	2,124
Total Soft Pines	1,679	65	995	74	3,045
Total Coniferous Species	3,314	82	1,644	74	6,686

The preceding figures for soft pines, though at first glance they might not seem to, provide very good evidence of the importance of western white pine to the national economy. They show that the soft pines, as a group, account for a sizeable proportion of the lumber production and fill a major segment of our wood requirements. The importance of the group may be taken as the importance of any one of the species in the group. It amounts to this. For a number of decades the supply of northern white pine was sufficient to meet the demands of everyone who wanted wood with high workability and any other of the properties belonging to the soft pines. More recently, ponderosa pine has carried the main load of that demand. However, now that the virgin timber supply is running low, it will take nearly the full producing capacity of all the soft pine forests to meet such demands in the future. This is both because a smaller percentage of the second-growth soft pine will have the qualities desired, and because there will be less of it available for cutting at any one time. Our present knowledge of the timber-growing capacity of the Nation's forests indicates that if as much soft pine is to be cut in years to come as in years past, more of it than at present must come from the white pine forests, for the present drain upon ponderosa pine lands exceeds their growth capacity.

One of the main conclusions which may be drawn from the Forest Service's reappraisal of the national timber situation is that taking into account human inertia, the Nation may never again have all of the timber it could use to good advantage. If our economy is to be discommoded to any degree by lack of wood, it seems likely that the pinch will be greatest in the quality woods. The pinch has already been felt in high grade hardwood veneer logs, in white oak for tight cooperage, in the top quality Douglas-fir plywood logs, and in some other instances. The pinch may not be many years off for the better grades of soft pine lumber, all of which gives added reason for continuing to grow white pine in the region -- the best white pine possible.

Some may ask why make a special effort to grow white pine when a large percentage of it is manufactured into matches? This opens up a subject with a number of ramifications which do not need to be discussed here. Without passing judgment as to the desirability of this form of use, we can point out that the wood consumption pattern of this Nation is not static. As quality timber in the United States becomes scarcer, natural forces will tend to get white pine into the highest type of use.

Quality Should Not Be Discounted

The quality problem in the national timber situation has not been fully appreciated in years past. To a certain extent, our perception has been dulled by the accomplishments and apparent accomplishments of forest products research in the direction of enabling us to get by with poorer raw materials. Some of the more enthusiastic prophets foresee the day when unreconstructed boards will be in minor demand, and our main objective will be to grow fiber. If we could be sure that these prophecies would pan out, there would be little reason for a special effort to grow white pine now for consumption decades hence. Yet, the fact remains that research thus far has changed the wood consumption pattern to but a minor degree and there is still a premium on quality. Moreover, it still remains to be proven that wood, in its natural state, will not always be the cheapest raw material for many purposes. G. N. Arneson, in an article on forest products research, has some pertinent observations (1):

> ".......We emulate the 'House of Magic' publicity technique and display the marvels of heat-stabilized or urea plasticized wood and transmutation of softwoods into hardwoods. We introduce plastic ash trays made of lignin; the products of wood distillation; oil from pine needles; and alcohol from the sawdust pile.
>
> "It all seems like big-time stuff and that forest products research is right along in achievement with metallurgy, medicine, electronics, photography, etc., but there is a hitch to it. The comparison is not usually valid and we should recognize it frankly.....
>
> "Whereas, for example, the achievements in metallurgy have changed aluminum from a semi-precious metal to a cheap and abundant material to use in building everything from saucepans to ships and houses, heat-stabilized wood and compreg have found no practical uses except for a few specialties.
>
> "Vitamins, penicillin, and insulin are protecting the well and healing the sick by thousands the world over, but on the other hand, urea plasticized wood and the transmutation of softwoods into hardwoods are still impractical laboratory phenomena and lignin plastic ash trays are not made because other plastics are better and cheaper."

Arneson's point, made as a friend and advocate of forest products research, is that exuberant statements in the past have tended to create a glorious misconception of the practical applications of this research. Our point is that while the field of wood technology appears to have a great many opportunities, there is nothing in the cards as yet to indicate that we should sell our white pine short.

To sum it all up, there appear to be two major conclusions which may be drawn from the facts now available. First, the future national wood supply situation, as we see it now, indicates that the country will need all the white pine that this region can produce at reasonable cost. Second, it would be a serious mistake to allow any hopes of possible technological advances in wood utilization to divert us from the objective of growing an adequate supply of soft pine.

III. REGIONAL IMPORTANCE OF WHITE PINE

Within the white pine belt of Northern Idaho, Northeastern Washington, and Western Montana, white pine has been the mainstay of the lumber industry. Therefore, it is only logical, in deciding where to go from here with blister rust control, to consider how much the region may need white pine in the future. The best way to do that seems to be to analyze the factors which have made this species so important in years past, and then to consider what effect the changing economic and resource situation will have upon these factors.

Fortunately, it is not necessary to consider anything but the commercial importance of white pine. White pine is probably no more or less important than any other tree, so far as watershed protection and recreation go. It grows in a mixed forest. If all of the white pine is killed, the ground will, in general, still be well covered and the requirements for watershed protection and recreation adequately met. In certain instances, the killing of trees by the disease may temporarily impair recreational values, but it is hard to see how it could do any great or lasting damage.

Just what the loss of white pine might mean in an ecological way is not known. Many damaged and dying trees of pole and sawtimber size would, of course, occupy valuable growing space for several decades, but perhaps that would not be the only effect of blister rust damage. Some foresters have expressed the opinion that elimination of such an important species as white pine might upset the ecological balance and create new difficulties of a timber growing nature. Too little is known on this subject to either discredit the threat or to prove how serious it is, and therefore, it can only be said in passing that failure to control blister rust may result in other problems later on.

IMPORTANCE OF THE LUMBER INDUSTRY

First, consider the position of the lumber industry in the economy of the Inland Empire.

The forests, which occupy so much of the landscape in this region, have naturally played a major part in its development. Lumbering gave many communities their start. Spokane, Washington, the metropolis of the region, and many smaller

towns have been heavily dependent upon sawmills and secondary lumber-using plants, such as match block and sash and door factories. The importance of these forest industries in the aggregate is illustrated by statistics for Northern Idaho. There are in Northern Idaho, judging by the last decennial census, around 136,000 people. Taking into account the grocery clerks and other employees in secondary industries dependent on the forest workers' pay checks and the families of all these people, about one-fourth of the total population in Northern Idaho is dependent upon income produced by the forest.

The following is a comparison of the three major basic industries in Northern Idaho:

Industry	Number of Workers	Value of Products
	1945	1945
Agriculture	8,945	$38,000,000
Mining	3,212	34,000,000
Forest	5,793	34,000,000

These figures make it obvious that it is going to make a difference to local communities -- a lot of difference -- what happens to the forest industries in Northern Idaho and the rest of the white pine belt.

PAST DEPENDENCE OF THE LUMBER INDUSTRY UPON WHITE PINE

Lumbering has been, by far, the largest and most important of the forest industries. Nine-tenths of the timber cut goes to sawmills. This lumber industry has been mainly dependent upon white pine (15). Although only one-quarter of the timber stand in Northern Idaho is white pine, almost one-half of the lumber cut there since the beginning of the century has been of this species. (See figure 11.)

In 1932, when the lumber industry was hard-put to stay alive, eight-tenths of its production in Northern Idaho was white pine. Most of the successful mills have concentrated mainly on this species in years past. Men who have watched the ups and downs of the lumber industry point out that up until the recent war it was not financially possible for most mills in this area to cut much lumber of other species.

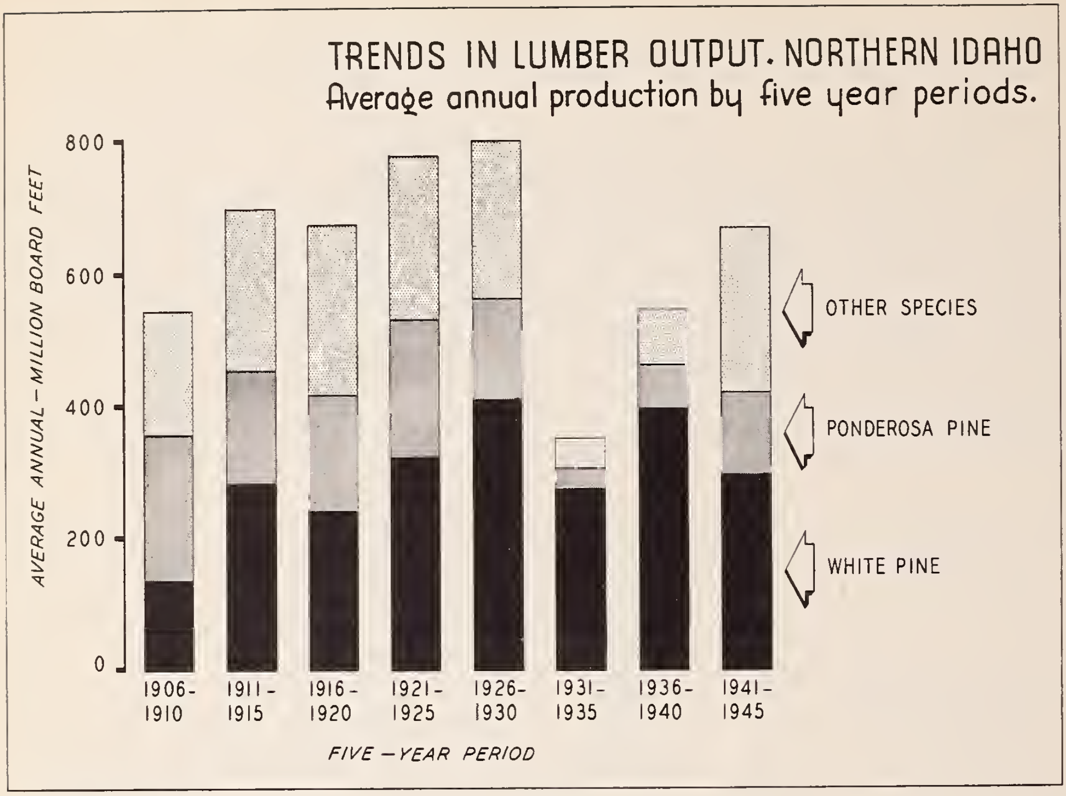

Figure 11.

Lumber selling value statistics emphasize even more strongly the dominant position of white pine. White pine lumber has always brought a higher price than grand fir, larch, and the other associated species. The difference in average price has been as great as 30 dollars per thousand board feet. From 1913 through 1945 the total value (at the mills) of all lumber produced in Northern Idaho was 614 million dollars. The total value of the white pine in the same period was 359 million dollars. Ponderosa pine had a value of 120 million dollars, and the value of all other species was only 135 million dollars. Ponderosa pine does not commonly grow in the white pine belt proper. Therefore, the above figures show that roughly three-quarters of the lumber value produced by the mills of the white pine belt has been white pine -- this from a forest less than one-third white pine. In 1932, 93 percent of the total lumber value was white pine. (See figure 12.)

Figure 13, compiled from data gathered by the Forest Service and the Western Pine Association, indicates why the sawmills have concentrated so heavily upon the white pine. This figure compares marketability indexes of white pine and its associated species. The index shown here for <u>white pine</u> is the margin between average lumber selling value and average

production cost (not including stumpage cost). During every year except one since 1916, the selling value of white pine lumber has been higher than the average production cost of white pine mills. In figure 13 also is the index of marketability of the other species in the white pine zone, during the same period.

In computing the index for the non-pine species, the average production cost of all mills was determined, including those which cut little or none of this timber. This was necessary in order that this index be comparable with the white pine index. For example, let's suppose that the index for non-pine species in the white pine zone was based on just two mills instead of many mills. Let's suppose further that in a particular year it costs one of these mills $15 per thousand board feet to produce lumber (not including stumpage cost) and the other mill $25 because of a less efficient plant and less accessible timber. If the average lumber selling value of the non-pine species is $20 per thousand board feet, the mill with a production cost of $15 could cut this timber freely, as long as the price of stumpage did not squeeze out the profit. On the other hand, the mill with a $25 cost would be forced to stick mainly to white pine, assuming the value of the pine exceeds the production cost of the mill. Such non-pine timber as this mill cuts will be subsidized by the white pine.

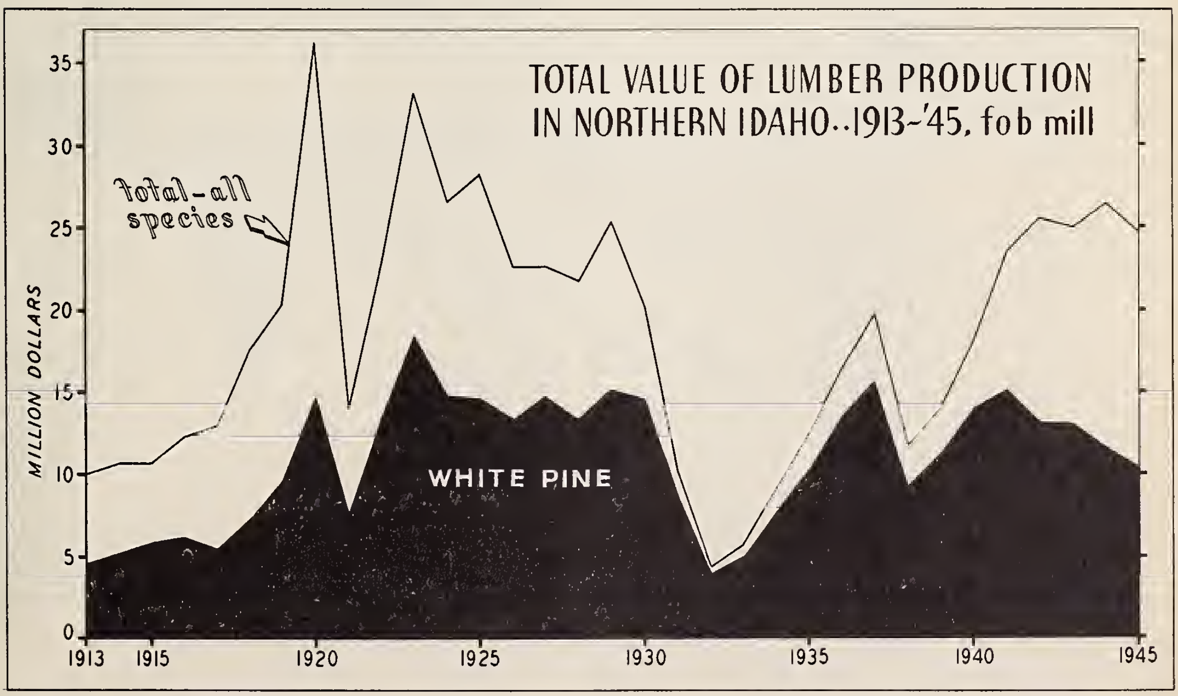

Figure 12.

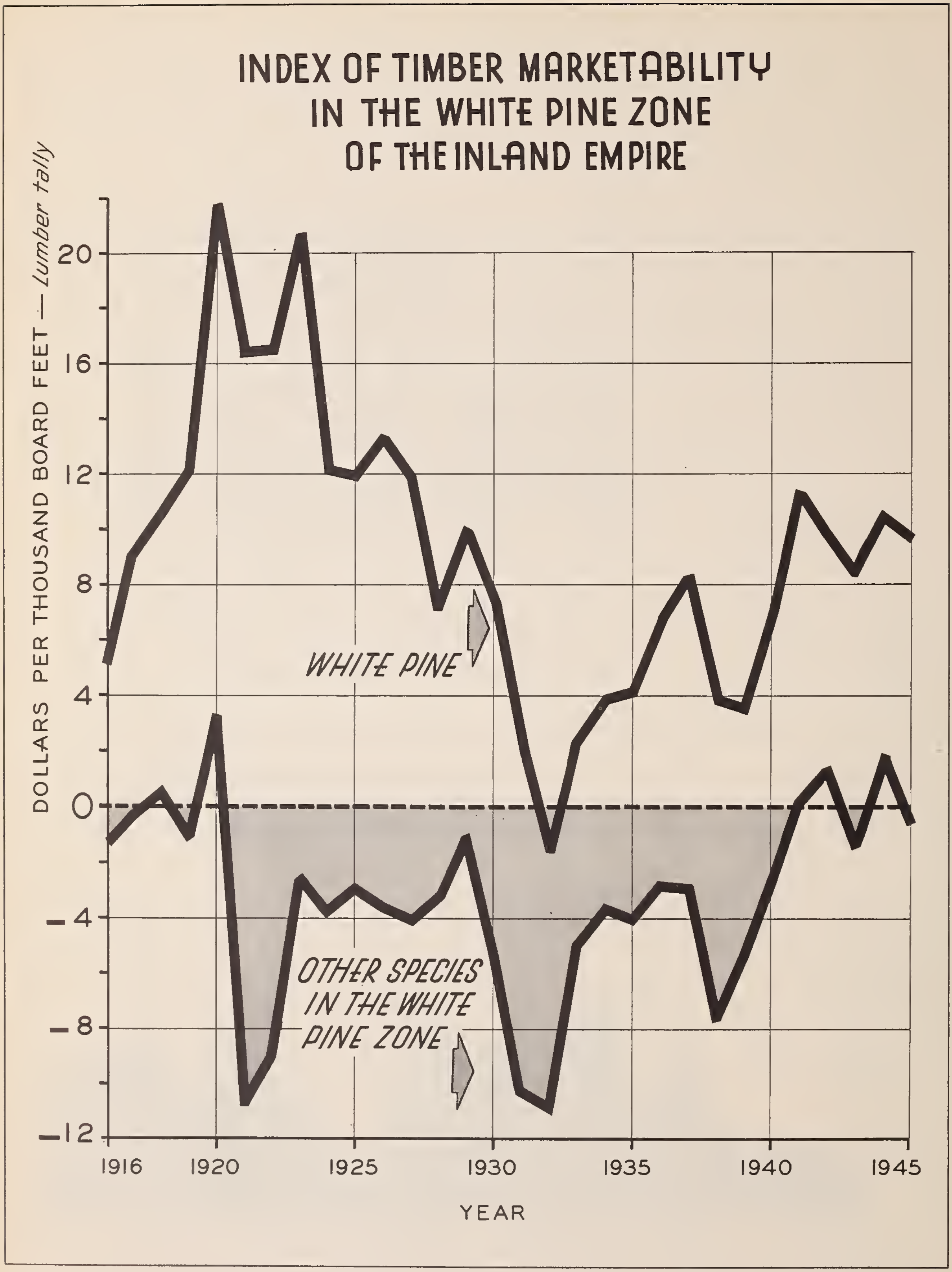
INDEX OF TIMBER MARKETABILITY
IN THE WHITE PINE ZONE
OF THE INLAND EMPIRE
DOLLARS PER THOUSAND BOARD FEET — Lumber tally
20
16
12
8
4
0
-4
-8
-12
WHITE PINE
OTHER SPECIES
IN THE WHITE
PINE ZONE
1916
1920
1925
1930
1935
1940
1945
YEAR

Figure 13.

The average production cost of the two mills in this case is $20, and the average selling value of the non-pine species is also $20 for what might be called a marketability index of zero. If the average selling value of the lumber were $30, the marketability index would be plus 10. If the selling value were only $12, the marketability index would be minus 8.

Obviously, when average production costs are equal to average selling values, the lumber industry cannot cut unlimited quantities of non-pine timber. As the index drops below zero, more and more mills must curtail their cut of these species. In 1932, when the index for the non-pine species reached minus 11, eight-tenths of the lumber cut in Northern Idaho was white pine.

The marketability index for the non-pine species in the white pine zone was negative for every year from 1921 through 1940. From 1941 through 1945, it hovered around the zero mark. Since then selling values have risen more than production costs, so the marketability indexes for the non-pine species during 1947 were undoubtedly higher than ever before.

Figure 13 emphasizes three points:

1. The lumber industry of the white pine belt would not be what it is today, if it had not been for the white pine (19) (28).

2. Past lumber production from species associated with white pine has largely been subsidized by the pine which has paid the high cost of opening up the country (29).

3. Despite the subsidy by white pine, the level of prices up through 1945 set a relatively low ceiling on the volume of the associated species which could be profitably produced under the existing industrial setup (18) (27).

Another point to consider is that instead of turning more and more to the associated species, the lumber industry was, prior to 1941, turning away from them. In that connection, figure 14 is interesting. It shows that though the apparent operating margin for these species greatly improved from 1932 to 1940, their output did not rise correspondingly in that period.

Improvement in Recent Years

Since 1940 the picture has certainly changed. In response to much better prices and war demand, the cut of the non-pine species mounted rapidly -- and the optimists came out of hiding. With this improvement in the situation it has not been so necessary to cut white pine to keep going, and the production of that species has dropped off. However, as this is written in 1948, there are once again signs of distress in the markets for some of the non-pine species.

This brings us up to the question of whether the recent, greatly increased flow of non-pine lumber from the Inland Empire sawmills presages a permanent expanding opportunity for these species. To answer this one must consider whether there has been any fundamental change in the factors which have contributed to the past market position of these species. Past experience taken alone gives little clue to what the future holds. The production curve of the 1940's could be the beginning of an upward trend or merely the result of a temporarily good market.

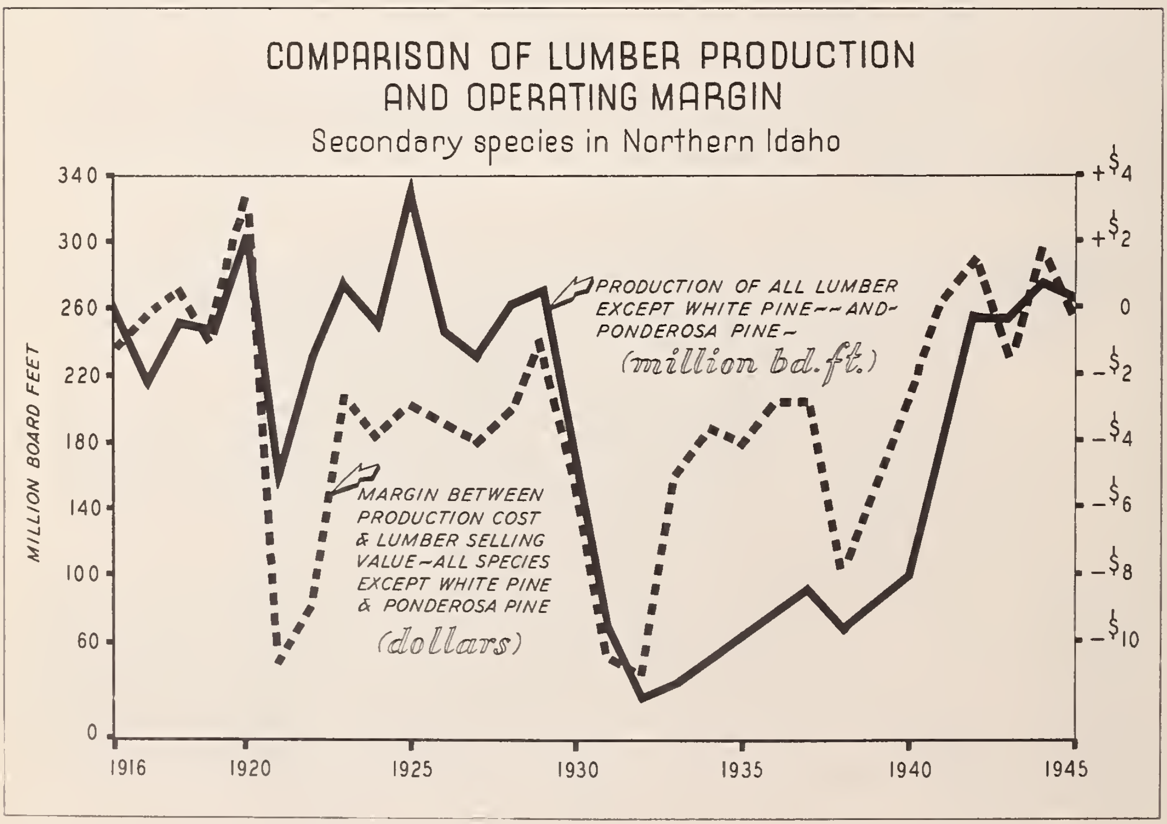

Figure 14.

FACTORS CONTRIBUTING TO WEAKNESS OF OTHER SPECIES

The principal selling point of white pine is a softness and texture which gives this species a superior workability and other intrinsic qualities that make it suitable for use in products of high quality and value. On the other hand, most of the species associated with it have been sawed into lumber products for which strength, toughness, wearability, and low cost are the principal requirements. Thus, as table 5 suggests, these associated species run into relatively little competition from white pine.

Table 5. Classification of Lumber Grade Recovery Inland Empire - 1940

Grade	Western White Pine	Larch Douglas-fir	Grand Fir
	- - - - - Percent	- - - - -	
Select	10.9	6.6	----
Shop	3.6	----	----
Common	85.5	15.3	9.9
Dimension, ties and timbers	00.0	78.1	90.1
TOTAL	100.0	100.0	100.0

Lumber from the non-pine species does, however, enter a field dominated by southern pine and West Coast Douglas-fir. Within that field it comes into direct competition with the Coast fir. The under-utilization of these Inland Empire species traces back directly to this competitive situation. Grade recovery data available for Inland Empire and West Coast sawmills are not strictly comparable, but the following figures indicate how great a proportion of West Coast Douglas-fir timber is cut into the same general products as are the non-pine species of the white pine region:

Grade Recovery of Average West Coast
Douglas-fir Log Which Goes To Sawmills

	Percent
Clear lumber	20
Select dimension and timbers	20
#1 dimension and timbers	35
#2 principally dimension	15
#3 principally dimension	10
	100

Past experience has demonstrated that the competition between the Inland Empire species and the West Coast fir has been one-sidely in favor of the Coast fir. In order to evaluate the prospects of the Inland Empire non-pine species in the future lumber market, it will be necessary to consider the major factors which have, in the past, made the competition one-sided. Coast mills have had two big advantages:

Better quality timber is advantage number one. Grade recovery certainly favors the West Coast mills. The preceding tabulation shows that 20 percent of the average Coast fir log is clear lumber and another 20 percent select dimension, in contrast with 7 percent select lumber from Inland Empire larch and the negligible quantity of select grand fir lumber. Non-pine lumber in the Inland Empire is of better quality than the figures indicate, because lack of volume production and lack of markets have discouraged segregation of quality material to the degree possible. Granting this, the grade realization of Coast fir is so much higher as to give plants of that region an overwhelming advantage in this respect.

Advantage number two is lower producing costs. Smaller timber and lighter stands handicap the Inland Empire. Because of larger diameter and greater length, the average log on the West Coast has something like fourteen times as much volume as an Inland Empire log. Even more important is the much greater volume per acre in the old growth stands on the Coast. At the time of the original forest survey in the early thirties, the average sawtimber stand in Western Washington and Western Oregon contained 43 thousand board feet per acre (log scale) as compared to about

15 thousand in the average sawtimber stand in Northern Idaho. Douglas County, Oregon, alone contained fifty percent more sawtimber than the ten counties of Northern Idaho. Needless to say, heavy stands of big timber have made for cheaper logging on the Coast. Likewise, the large logs have made lower milling costs possible. Figure 15 compares the average lumber production cost reported by the West Coast Lumbermen's Association from 1926 through 1940 with the cost at mills in the white pine zone (stumpage price not included).

The Inland Empire is favored by one factor. It is 400 to 600 miles closer to the principal consuming centers than the Coast. However, its geographical advantage is nullified by the freight rate pattern. Low-cost water transportation from Pacific Coast ports through the Panama Canal to the Atlantic Seaboard is said to have resulted in a lowering of rail freight rates from the Pacific Coast to eastern points. In any case, the pattern of rail rates prevailing for several decades has placed Seattle and Portland mills as close, or almost as close, to any market in the interior of the country as Spokane and North Idaho plants. Following is a tabulation which shows the difference in 1947 between the rail lumber haul rate from Portland and Spokane to several destinations:

	Amount by which the lumber freight rate (per 100 lbs.) from Portland, Oregon, exceeds the rate from Spokane, Washington - 1947
Bismarck, North Dakota	$0.060
Lincoln, Nebraska	0.035
Kansas City, Kansas	0.035
Denver, Colorado	0.085
Salt Lake City, Utah	0.050
Des Moines, Iowa	0.035
Chicago, Illinois	0.035
Philadelphia, Pennsylvania	0.000

The differential to these points has not changed materially for a number of years, although the rates themselves have been changed.

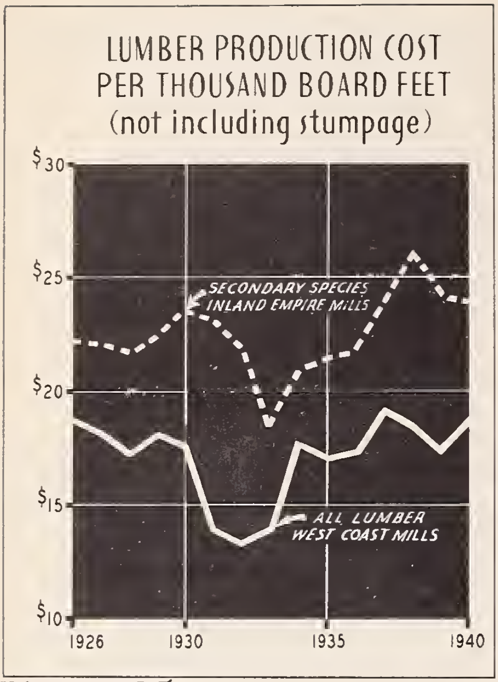

Figure 15.

Actually, the preceding rates make the competitive position of the Inland Empire mills in the eastern market look far better than it really has been. A large part of the output of West Coast mills has been shipped by boat to the East Coast, as well as to California and to foreign markets. This type of transportation has been much cheaper than by train.

Size of the Handicap

The net competitive disadvantage of the Inland Empire non-pine species cannot be measured accurately, but we can, in a rough way, show the theoretical dollar disadvantage under which these species have labored in years past. We can base this calculation on three factors already mentioned: grade recovery, production costs, and transportation costs.

Obviously, when other things are equal, timber which yields a high percent of select grades has greater value than timber which produces less than 10 percent. Because of this difference in grade recovery, West Coast Douglas-fir lumber has been worth at least $2.80 more per thousand board feet than the Inland Empire non-pine species. This figure was obtained by recalculating an average value for the Inland Empire species in 1940, based on Douglas-fir prices in that year. It is only an approximation, because lumber grades in the two regions are not strictly comparable. The quality difference between Coast fir and non-pine Inland Empire timber is definitely understated, because an increasing percentage of the best quality Coast fir logs is being diverted from the sawmills to plywood plants, thus lowering the lumber grade recovery in that region.

A report, "The Douglas-fir Lumber Industry," (4) presents production cost data for West Coast mills. Figures from this report, when compared with the production costs of Inland Empire mills, show that during the period 1934 to 1940 inclusive, the average cost of producing lumber of the Inland Empire non-pine species was about 5 dollars higher per thousand board feet (not including stumpage)

than the average production cost at West Coast mills.

Taking the regional differences in production costs, selling values, and transportation costs into account, we come out with the composite figures in table 6. They show, in a general way, the size of the handicap which has in the past prevented full utilization of the non-pine species in the Inland Empire.

Table 6. Relative Competitive Positions of Lumber of Inland Empire Non-pine Species and West Coast Fir

	Grade Recovery Advantage of Coast Fir 1940	Production Cost Advantage of Coast Fir 1934-1940	Railroad Rate Advantage of Inland Empire Species 1947	Net Disadvantage of Inland Empire Species
	per thousand board feet lumber tally			
Bismarck, N. D.	$2.80	$5.20	$1.99	$6.01
Lincoln, Neb.			1.53	6.47
Kansas City, Kan.			1.53	6.47
Denver, Colo.			2.50	5.50
Salt Lake City, Utah			1.70	6.30
Des Moines, Iowa			1.58	6.42
Chicago, Illinois			1.63	6.37
Philadelphia, Pa.			0.92	7.08

During times when the sawmills of the Nation are not able to keep up with demand and, as a result, prices are high, the competitive handicap shown in table 6 is not a great deterrent to production. However, from the middle twenties until 1940 a buyer's market prevailed. Even the Douglas-fir mills of the West Coast were having their troubles then. Published figures (53) indicate that on the average the mills of that region lost money during most years from 1926 to 1940. Their market problem during those years was at its worst in the lower grades competing with Inland

Empire species. West Coast Lumber Facts had this to say in 1941: "The industry's outstanding merchandizing problem is the disposal of its 78.8 percent of middle and lower grade lumber, especially its 27 percent of Number 2 and 3. West Coast sawmills are frequently overloaded with this type of boards, dimension and timbers."

Percentage of the Total Softwood Lumber Consumed in Several States During 1943 Which Came from the Inland Empire and West Coast

	From Idaho and Montana Mills	From Oregon and Washington Mills
	- - percent - -	
Idaho	77	23
Montana	90	10
North Dakota	19	78
Nebraska	10	73
Kansas	5	50
Colorado	10	52
Utah	13	67
Iowa	12	67
Illinois	6	38
Pennsylvania	5	31

Figure 16.

Certainly, if the Coast fir mills were having market troubles and were running into red ink, the position of the Inland Empire non-pine species was bound to be less than satisfactory. Figure 13 indicates that was the case.

As a consequence of their competitive disadvantage, Idaho and Montana sawmills have supplied a much smaller share of the lumber for nearby western and mid-western states than have Washington and Oregon mills. (Figure 16.)

FUTURE OF THE NON-PINE SPECIES

The factors which have contributed in the past to the market weakness of the species associated with white pine are undoubtedly changing for the better. As pointed out in the preceding chapter, the national wood supply situation seems to be shifting from surpluses to long-time shortages. This should improve the marketability of these species.

The competitive disadvantage of this region resulting from the big timber and dense stands of the West Coast will

undoubtedly grow less in years to come. Those big Douglas-fir trees are being liquidated at a rapid rate. In a little more than a decade the sawtimber supply in Western Washington and Oregon has declined 18 percent. Another twenty years of cutting at the 1944 pace will reduce these stands 41 percent more. Timber operators on the Coast, if they considerably improve their management practices, could no doubt slow down the drain on high-value, low-production-cost virgin Douglas-fir. Nevertheless, even the most sweeping reforms can hardly stop the decline in average tree size and stand volume, which will bring that region closer to the level of the Inland Empire.

However, the day when the Inland Empire can compete with the West Coast region on an even basis probably is not just around the corner. For example, even if there were 41 percent less West Coast Douglas-fir sawtimber in 20 years than today, there would still be a substantial body of old timber left.

Because transportation costs are one of the competitive factors, it is possible to improve the market position of the Inland Empire species through adjustment of freight rates. For example, the rail distance from Portland, Oregon, to Bismarck, North Dakota, is 1,434 miles. From Spokane, Washington, to the same point is 1,059 miles. If the lumber freight rates were more nearly proportional to distance, the present differential of two dollars per thousand board feet in favor of Spokane might become as much as four dollars.

The current population increase in the western states and the industrialization of this section of the country may help the secondary species by creating a larger western market. Population in the West has increased 26 percent since 1940, compared with a 7 percent increase for the Nation as a whole. Additional development of the water power resources of the region will further stimulate population growth. This shift of population may not, however, change the Nation's market pattern to a major degree. At present, 13 percent of the people in the United States live in the West, but 38 percent of the total timber cut currently comes from this section of the country, and the West has about one-fourth of the Nation's timber-growing capacity.

Another possibility is the development of more efficient lumber manufacturing methods which may reduce production costs.

In the long run, the greatest opportunity for the secondary species of the Inland Empire may come through diversification of the forest industry in the region. In other words, pulp mills might provide a more stable outlet than sawmills for part of the non-white pine timber. Per capita consumption of paper products in the United States has climbed steadily for several decades. Forest Service experts, who have studied the situation, believe that the trend will continue upward. They believe that a more populous United States 50 years hence can, if reasonable prosperity prevails, use more than twice the volume of paper products it did in 1944. They see a proportionately much more limited opportunity for expanding lumber consumption.

	United States Production in 1944 in terms of timber drain (48)	Potential requirement 50 years hence if reasonable prosperity prevails
	- - billion board feet - -	
Lumber	34.4	40.7
Pulp and paper products	4.8	10.7

Significance of the Facts

It boils down to this -- so far as anyone can see now, the marketability of the non-pine timber in the white pine belt will be better in years to come than it has been during most past years. To that extent, the industries will not have to lean so heavily upon white pine as they did in the past. One factor, however, has not changed and is not likely to change -- the much greater profit margin of white pine for lumber in comparison with the other species. White pine has been a preferred wood in the United States for three centuries. There is no sign that this preference, which has meant higher prices and higher profits, will not continue. Efforts to grow white pine, therefore, can produce two results -- greater prosperity for the lumber industry and communities of the region in the future and a greater stability during periods of depressed markets which may very well occur in the future as they have in the past.

In 1928, E. E. Hubert wrote, "Let us not make the grave mistake of dropping a perfectly good bone and jumping into

the pool for a reflection which appears as good or better only to find we have lost both" (14). In 1946 C. S. Webb, Assistant Regional Forester, said, "......because of its economic importance to the region and its various localities........the only supportable position the Forest Service may take is that it will do its best to protect the white pine crop" (47). The evidence presented in the preceding pages certainly supports these views to the extent that the regional values make it seem highly desirable to perpetuate white pine, if that can be done at a reasonable cost.

WHITE PINE WILL NOT SOLVE ALL PROBLEMS

No matter what is done about growing white pine, a readjustment of the lumber industry probably cannot be avoided. Either the industry must swing permanently to cutting a higher percentage of other species, of which there are large quantities available, or it must shrink for a period of years. The present cut of white pine is much greater than existing stands can supply for long. By expanding our efforts to grow and protect white pine, we can insure high yields and a high sustained output of white pine in the distant future. Much less can be done, however, to increase the yield of present merchantable stands and stands to become merchantable in the next several decades. Thus, curtailment of lumber output in this period can only be avoided by cutting more of the other species.

Annual Sawtimber Drain in Northern Idaho

	White Pine	Other Species
	- - million board feet - -	
Average 1935-1938	351	273
1944	220	372
Maximum allowable in next 60 years	146	540

Some will ask whether, if once white pine production shrinks, the markets lost can be regained later. We can answer this by pointing out that the trend in supply of all soft pines will not necessarily coincide with the trend in white pine supply. Furthermore, as already mentioned, western white pine furnishes a relatively small percentage of the total soft pine output, and a temporary decline in western white pine production cannot, by itself, disrupt the soft pine market. Expanding production of western white pine in

decades to come may permit it to substitute, to a degree, for the other soft pines, just as ponderosa pine took up most of the slack when the production of northern white pine declined. Aside from that, as long as production costs are at a level which permits competition with other raw materials, there is little reason to fear for the marketability of a species with the highly desirable qualities of white pine.

Thus, even though white pine yields must shrink in the coming decades, it would still seem to be good business to take steps to increase the yields in this region to some higher level in following years, if that can be done at a reasonable cost.

IV. FACTORS TO CONSIDER IN FUTURE PROGRAMS

After analyzing white pine's weak and strong points, we believe there is a real justification for growing white pine as a permanent crop in the Inland Empire, provided the cost is reasonable. The regional economy of the Inland Empire will probably be stronger and more stable with white pine than without it, and white pine grown in this region will have value to the Nation as a whole. Having reached that conclusion, it is important to decide what is "reasonable cost." After that, some of the management possibilities should be considered.

Before launching into the discussion of reasonable cost and management possibilities, however, another matter requires attention. This is: Why grow a large part of the Nation's white pine in the national forests of the Inland Empire? The regional and national need for white pine seems to be clear enough, but from a national point of view, why is it so important to grow a large volume of white pine in this particular region?

The national forests of the Inland Empire, the special concern of this study, occupy a key position for the production of white pine for the Nation. This is because approximately fifty percent of the commercial white pine land in this region is national forest. This high percentage of public ownership is significant because the people of the United States exercise direct control over these lands. Intensive blister rust control and intensive white pine management can be applied to these public lands without the necessity of working through or with other owners. It is desirable to improve forest practices and grow white pine on the lands of all owners. But, it is not realistic to expect to be as successful in this endeavor on lands over which the public has little control as on the national forest lands which are publicly owned. Although eastern white pine lands are nearer the consumer and although blister rust control has been three times more expensive per acre in the Inland Empire as in the Lake States and five times as expensive as in the Northeast, only 7 percent of the commercial forest land in these two eastern regions is national forest compared to the 50 percent in the Inland Empire.

From the national point of view, it is necessary that the Inland Empire provide its share of forest products. In

order to meet this objective, timber must be grown of sufficient value to overcome the obstacle of high freight cost to market. Therefore, the growing of high quality white pine increases the availability of Inland Empire timber to supply the national wood need. This is one more reason why it appears to be sound public policy to grow white pine on the national forest lands of this region, insofar as that can be done at a reasonable cost.

WHAT IS REASONABLE COST?

Taking full account of the probable regional need for white pine and the probable national need, how much money are we justified in spending upon blister rust control and the growing of white pine in the Inland Empire? This, of course, is the same basic question we bump up against in many fields of conservation planning -- how far should we go with investments which pay off a long time hence, and how much should the interests of today be subordinated to those of tomorrow?

It is a hard question to answer because the size of the conservation program in this region should be in balance with the national conservation program, and there has been far too little thinking about how much of the national effort should be devoted to the care and management of our natural resources. Without this background knowledge of how big the overall effort should be, it is obviously difficult to determine what is a reasonable expenditure for any one resource in any one region.

A key factor, certainly, in determining a reasonable expenditure is what we expect to get back in stumpage value for each dollar spent on white pine growing. Figures presented later show that the stumpage return can be more than twice the cost of growing the white pine, thereby producing an interest return of about one percent. These figures by themselves, however, are not the only reasons for growing or not growing white pine. The case for or against such a program must rest in large part upon the social values discussed in the preceding chapters.

These social values suggest that we should not be in a penny-pinching frame of mind when we decide what is a reasonable expenditure for forest conservation. Anyone who considers how priceless our natural resources have been must certainly reach the same conclusion. Our resources, in their relative abundance, have been one of the main differences between this Nation and the others. They enabled

the United States to become strong, and they are our hope of staying strong. It follows, therefore, that an analysis of government spending for conservation cannot be reduced strictly to a mathematical calculation, and that the Nation needs to spend as much for conservation as is necessary to preserve national strength and security.

To say it differently, the function of most federal spending for conservation should not be mainly to make money but rather to provide an environment for prosperity in which private enterprise will flourish.

We have, in this country, reached the point where unless our thinking on the subject of public spending for forestry changes, there may soon not be enough timber to serve all of our needs. We raise the astronomical total of 300 billion dollars to fight a war, yet are failing to make the very much smaller effort necessary to keep strong the sinews of war and peace. The consequence of this short-sightedness shows up when we take stock of our timber supply. The Forest Service's most recent analysis of the situation indicates quite clearly that the United States has plenty of reason to be concerned about the timber supply. That study reveals that unless the country tries much harder than it has been trying, we will never even come close to producing the timber which it appears may be needed in the future.

We can sum it up this way: If the Nation is to continue to be prosperous, it must replace the forest-growing stock depleted in the course of our development, all of which tends to justify a heavier expenditure than otherwise in growing white pine. Moreover, we should strive to have our plans for blister rust control in proportion to the challenge set by the national growth goal.

We would have to spend from $1 to $100 per thousand board feet for the special measures required to grow white pine in different areas. Somewhere between these extremes is a reasonable ceiling. Unfortunately, in a complex economy like ours there is no formula we can use to precisely determine that level to everyone's satisfaction. Until someone develops a means for calculating whether national and regional well-being is worth 10 cents or 10 dollars per thousand board feet, we will have to depend on judgment. For that reason, it is not claimed that there is anything inviolate about the "reasonable cost" recommended here. It is our opinion (the authors') that the national values and the regional values in national forest timber justify

spending, if necessary, as many dollars to grow white pine as we expect to get back in stumpage values. Perhaps one can argue that it is desirable to go even beyond this "break-even" point. At any rate, a public program which returns the capital investment certainly is defensible if the other gains are sufficiently large, as they seem to be in this case.

The concept of reasonable cost developed in the preceding paragraphs has constituted the cost ceiling in this analysis. It is our answer to the question, "What is reasonable cost?" However, as later calculations show, it will not be necessarv to go as high as this ceiling.

What Kind of Costs and Values Are We Talking About?

Even if white pine is not grown, it will cost money to administer the forest land. The forests will have to be protected from fire, if for no other reason than to preserve watershed and recreation values. Whatever the primary justification for forest protection, certain direct revenues will be produced, chiefly in the way of stumpage income. In other words, there will be a cost and income no matter what the decision is about white pine. A policy of white pine management incurs extra costs over and above these more or less basic ones. These extra costs will be offset in some degree by the additional stumpage values produced. Therefore, the comparison in this study is between the additional costs involved in growing white pine and the additional timber value produced by this effort. The "break-even" point, mentioned in a preceding paragraph, is the difference between the stumpage value of future timber crops with white pine and the stumpage value without the white pine.

Some readers will no doubt wish the comparison had been between total costs and returns in the region, if white pine is grown, and total costs and returns, if it is not grown. That approach, considered very carefully, was not used for several reasons. In starting this study, it seemed that there are really two basic economic questions to be answered. First of these is whether the qualities and values of white pine make it worthwhile to go to extra trouble and effort to grow that species. If the answer is "yes," the next question is whether white pine can be grown at a cost which is reasonable. That can be decided more easily by confining the comparison to extra costs and extra values involved in growing white pine than it can by comparing all costs and all values involved in timber growing in the region. Consideration of all costs and values would

make it necessary to decide how much of the fire protection costs, etc., should be charged against watershed values, recreation, etc., and how much against timber growing. Taking such a course would multiply the complications many times, would not eliminate the judgment factor, and would assure no sounder answer.

The simpler method adopted in this study does give us a comparison between white pine and its associated species. As long as the added stumpage value obtained by growing white pine exceeds the added cost of growing the pine, any forest will make more money growing white pine than by not growing it.

The spending of money for white pine does not preclude the expenditure of additional funds to protect and grow other species on intermingled areas. As a matter of fact, if we see the picture correctly, the overall national timber supply situation and the economy of the region will, in the long run, make it desirable to grow and promote the use of the other species.

Stumpage Price Estimates

We can, of course, only guess how much different kinds of timber will be worth in years to come. The trend of stumpage prices in the past, when timber was relatively abundant, is no indication of what will happen to the price of timber in the future. Past stumpage price trends are a particularly poor basis for measuring what will happen in the case of white fir, larch, and the other species associated with white pine.10/ There are, nevertheless, three probabilities upon which we can base future price assumptions. First, the costs of many raw materials, including timber, are very likely going to be higher in the future than they have been in the past, because of less adequate supplies. Second, future stumpage prices will reflect timber growing costs which was not the case in the past, and because of this they will tend to be higher. Third, the stumpage price of white pine will probably rise more than the price of the other Inland Empire species (41). For the purposes of this study, therefore, it has been assumed that stumpage prices will climb steadily over the next century and one-half, to

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10/ Ponderosa pine is not included in this discussion for ponderosa pine does not, for the most part, grow well on white pine land.

the levels shown in the right-hand column in the following tabulation:

Stumpage Price Per Thousand Board Feet, Log Scale

	Average 1936-1945 All Sales All Owners	Assumed Upper Limit 140 Years Hence
White Pine	$6.50	$13.00
Associated Species	1.68	5.50
DIFFERENCE	$4.82	$ 7.50

You will note the assumption is that the stumpage price of white pine will be eventually twice as high as during the 10-year period, 1936-1945. Proportionately, the associated species may show a greater increase but the rise in dollars probably will not be so large as for white pine. These species enter a market in which large volumes of timber from all regions compete and therefore feel the competitive pressures more severely than white pine.

From the standpoint of this study the most significant point in the preceding tabulation is the assumption that the differential between white pine and its associated species will eventually increase from $4.82 per thousand board feet to $7.50. Considering what has already happened to stumpage prices since 1945, the assumed increase in differential probably is very conservative. During the third quarter of 1948 white pine stumpage sold by the national forests brought $23.38 per thousand board feet on the stump. The associated species brought $5.68 for a differential of $17.70. Even though lumber prices were unusually high in 1948, it is not at all unlikely that the higher differential is more representative of what will happen to stumpage prices than the figures presented in the preceding tabulation. In years past, development costs have been largely borne by white pine. Even so, stumpage values of the associated species have, in many instances, been negative. In those cases these other species have been sold for a nominal sum by reducing the sale value of the white pine sufficiently to offset any loss in the other species. The improved market position of the associated species in recent months has enabled these species to carry what is more nearly their share of the costs. Free from the drag of other timber, white pine stumpage values have, therefore, begun to reflect the full worth of this species and the

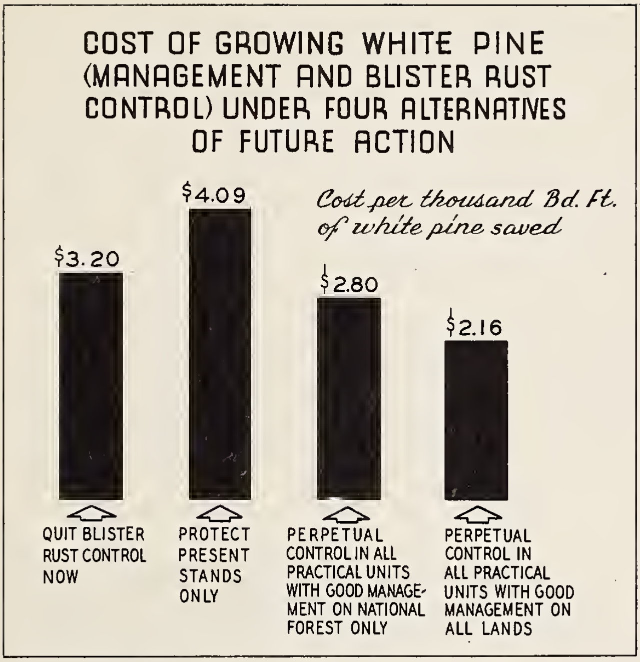


Figure 17.

differential has greatly increased. Thus, if one takes for granted that the marketability of the non-pine timber will remain higher in the future than in the past, he will conclude then the stumpage value assumptions used in determining reasonable cost are very conservative.

Low future stumpage values are assumed for one very good reason. It is the objective of public forestry to produce abundant supplies of wood at prices people can afford to pay rather than to obtain high returns at the expense of the consumer. Therefore, it seems to be in the public interest to keep the estimates of future returns on the low side when determining the "reasonable cost" of growing white pine on the national forests.

WHITE PINE CAN BE GROWN AT REASONABLE COST

Blister rust control is expensive as forestry costs go, and added to it are the other extra management expenses necessary to raise a crop of white pine from seed to maturity (7). How much it would actually cost to grow white pine depends upon the type of project undertaken. Figure 17 shows the white pine management and blister rust control cost per thousand board feet under four different assumptions in terms of 1947 dollars.[11] The range is from $2.16 to $4.09.

11/ The costs on this and following pages are not total timber growing costs but merely the blister rust control and other special costs required to grow one crop of white pine. Likewise the values are not total values but merely the additional stumpage return from the white pine produced by the additional costs.

The alternative assumptions shown in figure 17 are not in any sense proposed plans or programs. They are merely four very different courses of action that might be taken with respect to blister rust control and white pine management. Each course of action excludes the others and applies to all lands that meet certain specifications of maximum cost and ownership without regard to time of yield or any limit on total cost. Any plan would have a limit on total cost and an eye on the time of yield, and it might be a combination of several courses of action. The estimates in figure 17 are presented here to show how the costs of growing white pine under each of several assumptions compare with the $4.82 to $7.50 stumpage differential used as the break-even point in discussing reasonable cost. Suggestions for actual programs will be discussed in a later section of the report.

Cost estimates, such as those summarized in figure 17, are one of the most significant results of the study, for they answer the often argued question of economic feasibility. They show that white pine crops are justifiable under the limits of reasonable cost we have just discussed; that is, they can be grown at costs well below the break-even point.

Because the justification for blister rust control rests to a large degree upon these cost figures, it is important to point out that they are not based on casual armchair calculations but rather on a very intensive study of costs and returns of timber growing in the white pine belt. In this study the white pine belt was subdivided into 594 "working units" which, in the main, are separate drainages of 5 to 10 thousand acres. These units were laid out along topographic boundaries in order that each one could be managed and protected from blister rust, more or less independently of the others. They include nearly all of the white pine land in the region, both inside and outside national forest boundaries.

Half of the units -- selected by choosing every other one -- were studied in detail. Data for 301 sample units were obtained from existing records and the knowledge of men familiar with conditions on the ground. White pine lands were classified according to site quality, age, stocking, and blister rust condition. Past blister rust control costs were summarized by units. Future special costs of growing white pine under the handicap of blister rust were estimated. Probable future yields of one crop of white pine and other species were also estimated using tables provided by the Division of Forest Management in the Experiment Station.

These figures have made possible a realistic estimate of the quantity of white pine which can be grown and the cost of growing it.

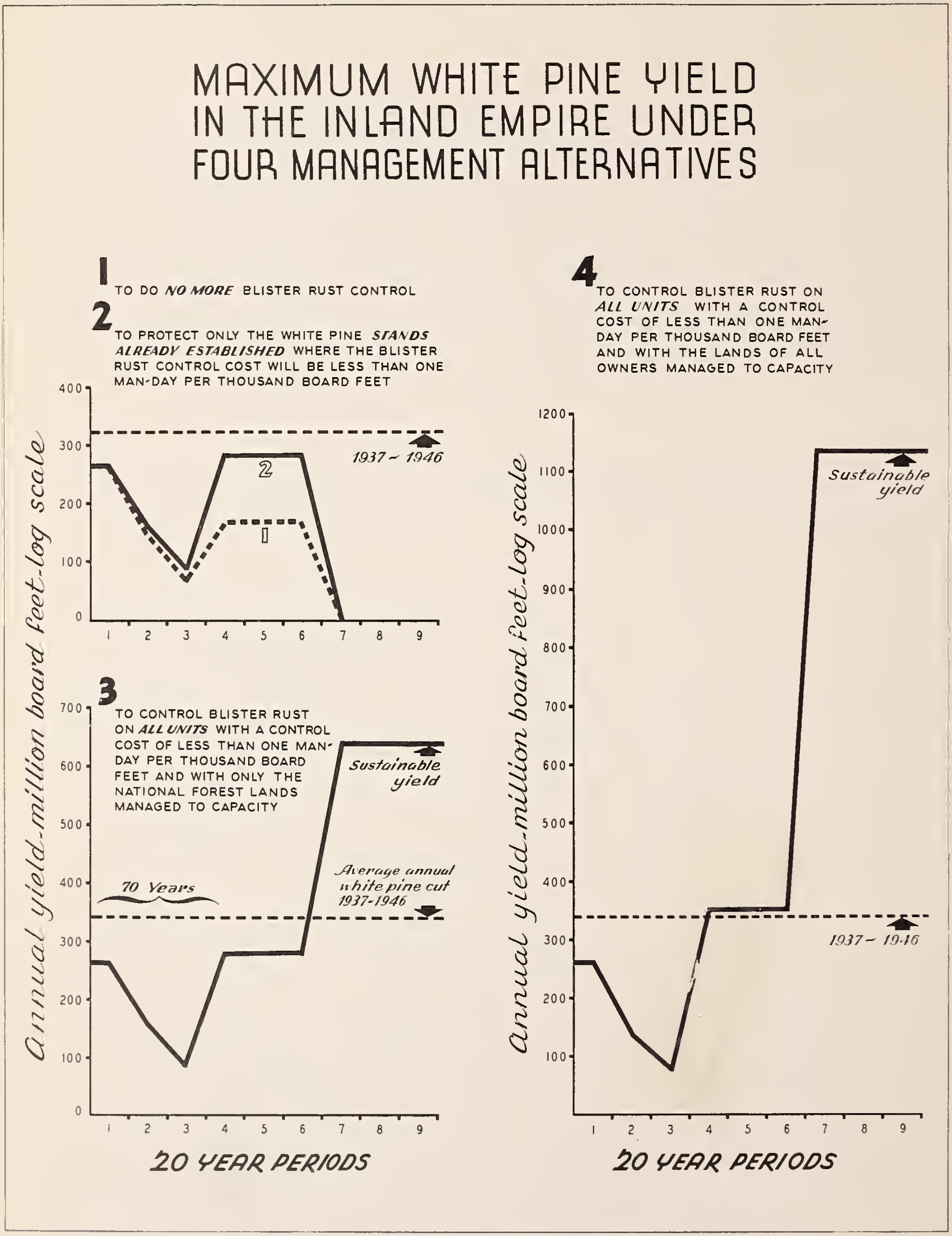
Although the primary purpose of this study is to suggest a desirable Forest Service policy, it has been impossible to limit consideration to national forest land. For one thing, land holdings are intermingled over the white pine belt, making it very difficult to analyze national forest ownership by itself. Then also, the decision on how far to to in growing white pine on the national forests depends upon yields likely to be obtained from other lands. Costs and white pine yields have, therefore, been estimated for the entire white pine area.

THERE ARE SEVERAL ALTERNATIVES

In deciding where to go from here with blister rust control, there are several broad alternatives, already mentioned, that the policy-makers will wish to consider from a cost standpoint.

They have the choice of quitting blister rust control now. Our estimates indicate that several billion board feet of potential white pine sawtimber have been saved on the lands of all owners by past ribes eradication work. If that estimate is correct, the white pine saved will have cost about \$3.20 per thousand board feet. Enough work has been done in stands of various ages so that even though no more ribes bushes are destroyed, there will be white pine to cut for well over a century hence. (See graph 1 in figure 18.) Abandonment of the blister rust control program would, however, mean the gradual disappearance of white pine as a commercial species.

A middle course for the policy-makers to select would be to continue blister rust control work but to confine it to existing stands without attempting to establish and protect new white pine stands. In that case, also, white pine would gradually go out of the picture but the yields in the intervening period would be greater than if blister rust control work were stopped now. This is shown in graph 2, figure 18. Just how much the cost would be in that case depends upon how many of the present stands are protected. For some working units the future cost will be \$2.00 or less per thousand board feet of white pine saved. If the protection of practically all present stands were undertaken, the total future blister rust control bill would run to about 36 million dollars or, when past costs



MAXIMUM WHITE PINE YIELD IN THE INLAND EMPIRE UNDER FOUR MANAGEMENT ALTERNATIVES
1 TO DO NO MORE BLISTER RUST CONTROL
2 TO PROTECT ONLY THE WHITE PINE STANDS ALREADY ESTABLISHED WHERE THE BLISTER RUST CONTROL COST WILL BE LESS THAN ONE MAN-DAY PER THOUSAND BOARD FEET
1937 – 1946
3 TO CONTROL BLISTER RUST ON ALL UNITS WITH A CONTROL COST OF LESS THAN ONE MAN-DAY PER THOUSAND BOARD FEET AND WITH ONLY THE NATIONAL FOREST LANDS MANAGED TO CAPACITY
Sustainable yield
70 Years
Average annual white pine cut 1937-1946
4 TO CONTROL BLISTER RUST ON ALL UNITS WITH A CONTROL COST OF LESS THAN ONE MAN-DAY PER THOUSAND BOARD FEET AND WITH THE LANDS OF ALL OWNERS MANAGED TO CAPACITY
Sustainable yield
1937 – 1946
Annual yield-million board feet-log scale
Annual yield-million board feet-log scale
20 YEAR PERIODS
20 YEAR PERIODS

Figure 18.

are included, about $4.00 per thousand board feet. Estimates by the Office of Blister Rust Control call for spending 15 million dollars in the coming years to protect only the best of these stands, in which case the cost per thousand board feet would be lower than $4.00

Another choice is to continue protection of present stands and to establish and protect new stands. This choice would result in growing successive crops of white pine far into the future. It would unite blister rust control and white pine management. Here also the cost per thousand board feet of white pine produced would depend upon the kind of program undertaken. Figures 17 and 18 show the possible costs and trends of production under two courses of perpetual control and production applied to all lands that meet certain specifications. Either course so applied would involve large total costs although the costs per thousand board feet appear to be reasonable.

If virtually all white pine lands of all ownerships were to be protected from blister rust and managed intensively for white pine, the future cost might be in the neighborhood of $2.16. By selecting only the best areas the cost might be as low as one dollar per thousand board feet. If intensive management of white pine lands can be achieved only on national forest land and if all of the national forest land were managed intensively, the cost of protecting and growing white pine would approach $3.00 per thousand board feet.

THE IMPORTANCE OF GOOD MANAGEMENT

If we are going to continue blister rust control, which in many cases will cost 50 to 100 dollars per acre, it will be essential at the same time to take steps to grow enough white pine on the protected acres to make the control effort worthwhile. As far as existing seedling, sapling, and pole stands are concerned, that means picking stands well stocked with white pine. It also means cutting and otherwise handling these stands so as to produce the maximum volume of pine. (Figure 19.)

Most of the present white pine stands were established following the many fires which swept through the Inland Empire in decades past. Man, in controlling the fires, has created conditions less favorable to the re-establishment of the pine. Moreover, his cutting methods on many areas have been such as to discourage pine seedlings. Thus, the trend is toward fewer and fewer new stands well stocked

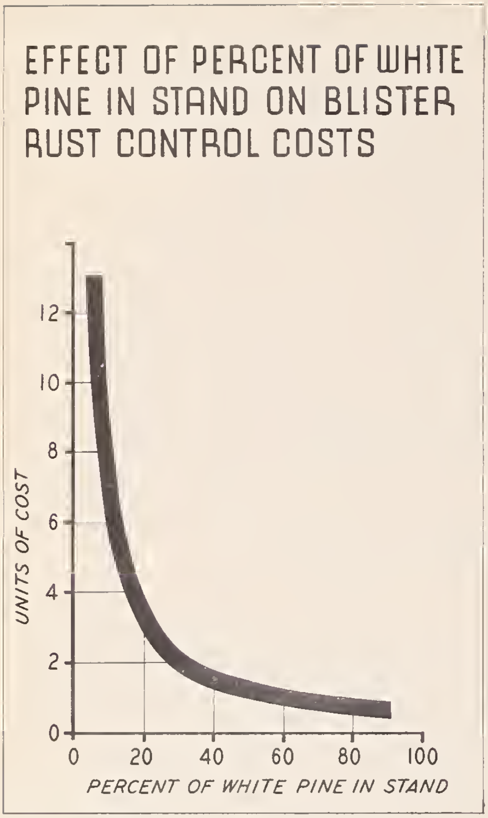


Figure 19.

with white pine. The situation is one which can be corrected by good management. We have little choice in the matter. If white pine is to be grown on most cutover areas, steps must be taken to re-establish good stands on those areas. Actually, we have a double opportunity. Management means can be used to reduce eradication costs per acre and to increase the yield per acre.

By cutting merchantable timber in several stages, germination of ribes seeds can be started under conditions not suited to their survival or good development (25) (26). In that way the number of bushes to be pulled can be drastically reduced before the area is cleared for the establishment of the next stand. In other areas the cheapest solution is to eliminate the ribes by a double burn and then to plant a stand of white pine (8) (20). Experience to date indicates that properly planned stage cutting of merchantable stands or pre-burning can reduce the ribes eradication job on cutover areas to a fifth of what it might otherwise be.

Yields Can Be Increased

As with agricultural crops, the per acre yields of forests can be increased by management. For lack of management, trees that die from crowding or are killed by insects or disease fall to the ground and are lost. Such trees contain much usable wood that can be recovered by light cuttings at the proper time.

The future yield from present young stands is limited by the percent of white pine and the stocking. The big opportunity to increase white pine yield comes when the land manager is starting a new crop. Then he can control the percent of white pine and the stocking by his silvicultural measures, including planting. By starting well stocked

stands of white pine, by doing some weeding and thinning as the stands develop, by salvaging the mortality, and by harvesting the crops to the best advantage the average per acre yield of white pine may be at least twice as high from future stands as from present young stands.

The estimates of future yields used in this study were related to the kind of management assumed. Where, except for blister rust control, a let-nature-take-its-course sort of management was assumed, yields similar to those obtained from a one-cut harvest of present unmanaged stands were used. Where intensive management measures were assumed, increased yields were also assumed.

Yield tables were prepared by LeBarron and Wellner of the Northern Rocky Mountain Forest and Range Experiment Station. A cross-section of their estimates is presented in table 7. These yields are for all species in the stands. The complete tables giving the yields for planted stands and natural stands of good, medium, and poor stocking by site classes, were based on the normal yield tables. Deductions from the normal yield tables were made to allow for less than normal stocking, defect and breakage, and losses due to fire, insects, and disease. In the multiple cut table prepared for the highest level of management these deductions were partially offset by allowances for salvage of mortality and the growth on reserve stands.

Some will want to know how the yields in these tables compare with normal yields. For their information it can be stated that the estimated single cut yields are only about two-thirds of the normal yield table values. According to an analysis made by the Forest Survey the average <u>current net growth</u> in the Inland Empire's white pine forests is about two-thirds of normal (6). Even the multiple cut yields estimated in this study fall considerably below the so-called normal yields.

These yields, believed to be conservative, were applied in ways that provide additional safety factors. Deductions were made for openings. A ten-year establishment period was allowed in addition to the rotation. No planting was planned on Site Class IV and V lands. No white pine yields were calculated for buffer strips around protected white pine stands although some yields will occur.

Once again it should be pointed out that ponderosa pine has not been considered as an alternative species for white pine on white pine lands. Experience indicates that in

Table 7. Examples of Per Acre Yields in the White Pine Type, Taken From Yield Tables Used in Study

Age of Stand When Cut and Type of Cutting	Conditions of Use	Total Volume of Stand[1] by Sites	
		Site	M. Bd. Ft. Per Acre
80 Years Single cut of white pine only	Liquidation cut of white pine alone to obtain stumpage return as soon as marketable. Other species cut by single cut at 120 years.	I II III IV	33 23 14 8
120 Years Single cut	Applied to white pine land not managed intensively.	I II III IV	59 48 35 23
120 Years Multiple cut over period of about 60 years	Applied to white pine lands intensively managed for perpetual crops of white pine.	I II III IV	83 65 45 29

1/Decimal C, good stocking, minimum d.b.h. 8 inches. In no case was it assumed that entire stand would be white pine.

most cases ponderosa pine does not do well on white pine sites.

Management is Going to Cost Money

To reduce blister rust control costs by good silvicultural practice and to build up white pine yields, we must spend more than ever before on management measures. In some areas it will be necessary to spend from 18 to 25 dollars[12/] an acre in burning off the land to reduce the ribes potential and to clear the way for new stands. Planting at a cost of 30 to 40 dollars an acre is desirable in many cases to insure adequate stands of white pine. Elsewhere the proportion of white pine in existing stands should be increased by weeding out the less desirable trees and species. This operation will take 30 to 40 dollars per acre. All these are out-of-pocket costs, the returns from which will come many years later. To grow white pine as cheaply as possible it would be necessary to spend almost as much for controlled burning, planting, and weeding as for blister rust control. In years past the outlay for management has not been more than a few cents for every blister rust dollar.

While these management measures cost money, the additional cost is more than offset by the greatly increased purchasing power of the dollar spent on blister rust control. So important is good management that permanent white pine forestry can be justified in very few working units without it, if future timber values are at the levels assumed in these calculations. If we fail to do the planting, burning, and other management practices necessary to obtain adequate white pine yield, the cost of permanent white pine forestry may exceed the break-even point (page 75) IN MORE THAN NINETY PERCENT OF THE WORKING UNITS. If we do these things the cost outlook can be completely reversed, and the total cost per thousand board feet of white pine (both management and blister rust control costs) will be above the break-even point in only 8 percent of the units.

12/ Future blister rust control and management costs have all been calculated at 18 dollars per man-day. That figure is not comparable to the man-day costs discussed earlier in the report for in it are overhead expenditures not previously included. The $18 is the amount that would have to be appropriated for each man-day of work.

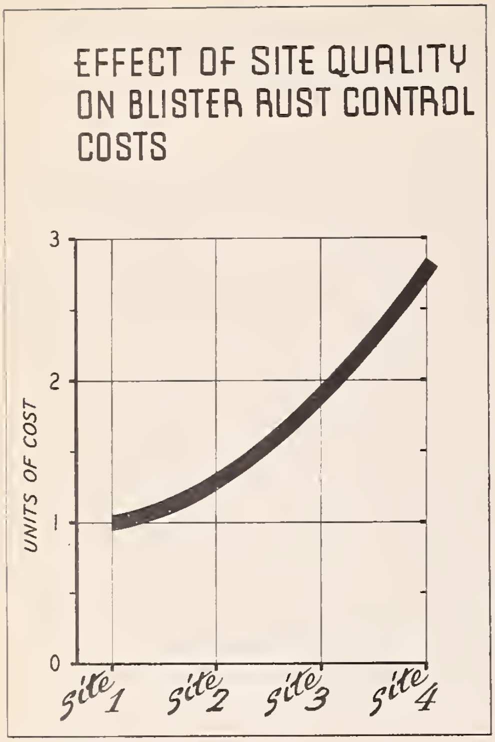


Figure 20.

<u>What is Good White Pine Management?</u>

Some of the management measures required to reduce the protection problem and to increase white pine yields have already been discussed. Good management requires something more, however (13). Starting with the selection of the best possible timber growing sites (figure 20), it involves, among other things, a willingness to let timber grow beyond the minimum cutting age. Length of rotation has a very important effect on the cost of growing white pine. As long as white pine is grown under the handicap of blister rust and as long as ribes eradication methods are unchanged, a short rotation is going to be much more expensive than a longer one and, in many cases, uneconomical. Why this is so can be seen in the comparison of long and short rotations in figure 21.

According to the silviculturists, the total sawtimber yield on average quality land under management will normally be two and one-half times higher at 120 years than at 80 years, and the yield per year one and one-half times higher. In other words, by adding 40 years to the rotation we increase the sawtimber yield sufficiently to reduce the cost of blister rust control 60 percent per thousand board feet of yield. Furthermore, if white pine is grown on a short rotation more area has to be protected for a given yield. These factors run up the risk and the cost. As figure 21 indicates, the forest manager's simple decision to cut his timber at an early age is enough to change a potentially good public investment in blister rust control into a bad one.

One of the advantages generally claimed for longer rotations is increased quality. In natural white pine stands, however, 80-year old timber has very nearly as much value per thousand board feet as 120-year old timber. But, should pruning prove practical it will be possible to grow trees of

EFFECT OF LENGTH OF ROTATION ON

COST OF BLISTER RUST CONTROL

Length of Rotation	80 Years	120 Years
Area in example	1 acre	1 acre
Site quality	$\frac{1}{2}$II-$\frac{1}{2}$III	$\frac{1}{2}$II-$\frac{1}{2}$III
White pine yield (Assumed to be 50% of the total stand in both cases)	9 M	21 M
Blister rust control cost per acre for life of stand	$63.00	$63.00
Blister rust control cost per M	$ 7.00	$ 3.00
Assumed increased value due to blister rust control	$ 7.00 per M	$ 7.00 per M
Net gain due to blister rust control	$ 0.00 per M	$ 4.00 per M
Rate of compound interest earned on blister rust control cost	0%	7/10 of 1%

By cutting the acre of white pine in this example at 120 years instead of at 80 years the blister rust control cost per thousand board feet is reduced from $7.00 to $3.00 and the net return is increased from zero to $4.00.

Figure 21.

substantially higher quality with the longer rotation.[13]

Ownership is Also a Factor

This brings us right up to the subject of ownership because it is the principal factor which determines the kind of management the lands receive. Even inside the national forest boundaries much of the white pine land belongs to other owners. The white pine management strategy of the Forest Service on its own lands, therefore, must take into account what is going to happen on the intermingled lands. For example, Forest Service efforts to grow white pine may be wholly or partly nullified by a flourishing ribes crop across the property line. Within a small drainage it is conceivable that as much ribes eradication might be necessary to make one acre safe for white pine as to make every acre safe. Control costs are not "fixed" to this degree, of course, in most working units, but it is generally the case that the ribes eradication job is not proportional to the area dedicated to white pine growing. In general, therefore, the smaller the proportion of the area in a unit devoted to white pine the higher will be the cost of protection per thousand board feet of pine.

Costs and yields in this study were calculated on two bases: First, with all owners taking the steps necessary to grow white pine at low costs; second, with only the national forests practicing white pine forestry. Until such a time as the Forest Service receives a guarantee that owners of intermingled lands will take the steps necessary to grow white pine on a permanent basis, its planning should be based on the latter set of calculations.

The point is not whether these other owners are practicing or will practice good forestry. It is whether they will be willing to practice good white pine forestry and to go beyond minimum good practices to the extent indicated in table 8. It is conceivable that none of the other owners will regard the rate of return high enough to justify making a heavy investment in white pine forestry. As long

13/ The reader by this time will recognize that good or intensive white pine management involves much more than good management in an ordinary sense. A land owner may protect his forest from fire and cut it in such a way as to insure high yields but unless he goes much farther than that he will not have much white pine in his future crops.

Table 8. The Two Levels of Management Assumed in This Study

Practices intentionally designed to obtain maximum production of white pine at lowest cost.	Practices not aimed to obtain maximum white pine production.
Present stands harvested by cutting practices that: 1. Purposely minimize germination of ribes seed stored in duff. 2. Purposely obtain maximum stocking of white pine. 3. Purposely use fire to reduce cost of ribes eradication. 4. Purposely avoid cutting posts, poles, wood, etc. in white pine stands when and where it will add to the cost and difficulty of ribes control.	Present stands harvested by cutting practices that: 1. Unintentionally maximize germination of ribes seed stored in duff. 2. Unintentionally tend to obtain less than maximum white pine stocking. 3. Provide no use of fire -- tending to increase cost of ribes eradication. 4. Unintentionally disturb white pine stands by frequent cutting of posts, poles, wood, etc., thereby increasing difficulty and cost of ribes eradication.
Long rotation and multiple cuts to obtain high yields and high quality.	Short rotation and single cuts for quick returns, resulting in low yields and poor quality.
Plant or weed if necessary, to obtain a high percent of white pine in the stand.	No planting or weeding, resulting in a low percent of white pine in many stands.
Manage selected working units on a perpetual basis. Result: A sustained yield of white pine at minimum cost per thousand board feet.	Protection of present stands, principal concern. Result: Liquidation of white pine and high costs per thousand board feet.

as this is a possibility the Forest Service should concentrate its white pine growing in those areas where its objectives can be accomplished with least dependence upon other owners.

Figure 22 shows that lacking the assurance of satisfactory practices for future white pine management from other owners, permanent white pine forestry is outright impractical or of doubtful practicability in many units because of insufficient national forest acreage.

EFFECT OF OWNERSHIP ON PRACTICABILITY

OF BLISTER RUST CONTROL

	Percent of units in which total management and blister rust control costs exceeded break-even point of 1/3 man-day per thousand board feet.
"Working Units" with 0-5 percent national forest land	94
"Working Units" with 6-50 percent national forest land	74
"Working Units" with 51-95 percent national forest land	25
"Working Units" with 96-100 percent national forest land	12

Figure 22.

The present mixed ownership is such a potent factor in increasing costs that in many units it would be cheaper in the long run to acquire the other land than to attempt to grow white pine on the present national forest land only. For example, on the St. Joe National Forest in the group of working units included in one possible program, future costs will amount to over $5 per thousand board feet for blister rust control and management under the present mixed ownership pattern. This program would produce 2.6 billion

board feet of white pine over the years. If these same units were all national forest ownership or entirely managed for white pine, we could produce 11.4 billion board feet of white pine at a cost of about $2 per thousand. In other words, we could, if there were no alternative, spend a considerable sum acquiring intermingled lands and still grow more pine at much less cost. Coordination of management, if not consolidation of the ownership itself, is one of the biggest opportunities to reduce the cost of growing white pine.

The land ownership problem is such an important factor in economical blister rust control and white pine management, we should point out that the muddled ownership situation is not being cleaned up with the necessary speed and dispatch. Figure 23 shows a typical land ownership pattern on the west side of the white pine belt. You will note that there is national forest land outside the proclaimed national forest boundaries established by Congress. These lands were acquired by donation from private owners and the counties, and can be blocked up only by donation. The Forest Service lacks the legislative authority to make exchanges and purchases outside the proclaimed boundaries for the purpose of blocking up either its own or other holdings. In other words, as far as most effective management is concerned, these parcels are stranded. Purchase and exchanges are permitted inside the proclaimed boundaries, but consolidation moves slowly, even there, for the lack of funds to acquire lands.

Local governments tend to resist any expansion of the national forest acreage because of the effect on the tax base. First of all, therefore, there needs to be an equitable solution of this problem. Then the state, counties, federal government, and other interested parties should reach an agreement as to the changes needed in the ownership pattern in the white pine belt to achieve the greatest long-time good. The federal government should thereafter proceed to consolidate the national forest holdings under such a plan, by purchase and exchange.

Management Involves Other Control Problems

Recurrently the forests of the Nation have suffered high losses from insect and disease infestations. In many cases the losses have been magnified by the overmaturity of the timber, so it is to be expected that they will diminish in importance as the forests are brought under management. An attempt has been made to take into account future losses

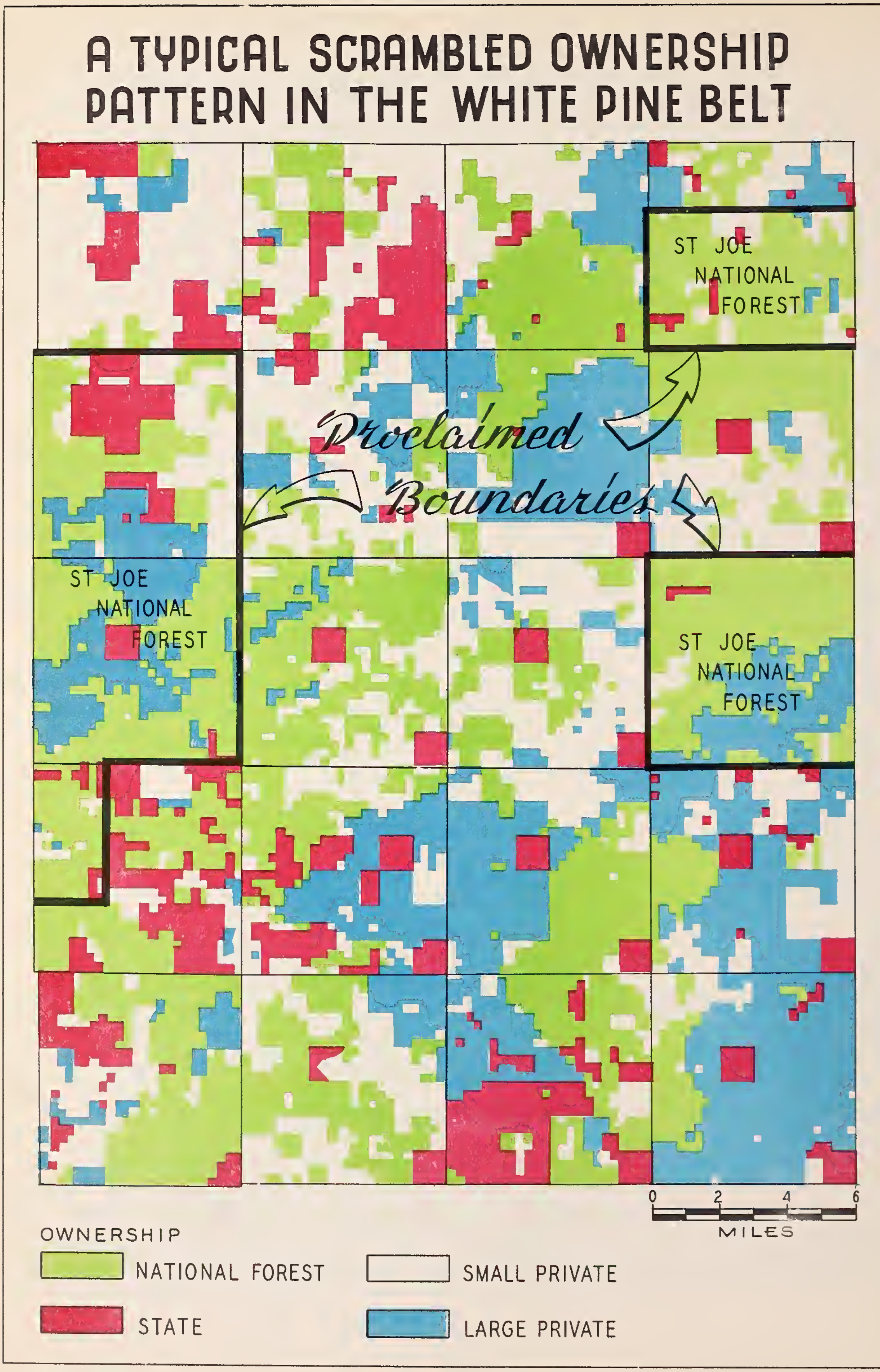

A TYPICAL SCRAMBLED OWNERSHIP PATTERN IN THE WHITE PINE BELT
ST JOE NATIONAL FOREST
Proclaimed Boundaries
ST JOE NATIONAL FOREST
ST JOE NATIONAL FOREST
0 2 4 6
MILES
OWNERSHIP
NATIONAL FOREST
SMALL PRIVATE
STATE
LARGE PRIVATE

Figure 23.

from other causes than blister rust by reducing yield estimates. It has been assumed that the cost of protection from insects and other diseases will be no greater if we grow white pine than if we grow other species. All species have their disease and insect depredators. The most recent example of this was the tussock moth infestation which might have done very great damage to white fir, hemlock, and the other secondary species if it had not been dealt with promptly.

During the past several years pole blight, another disease of white pine, has attracted considerable attention (52). Already it has decimated pole stands of white pine in several localities. Just where it will appear next, or how much more damage it will do, no one knows. In fact, investigators know very little about the blight itself. Because pole blight is still an unknown quantity, current investigations of that disease should be pushed to determine what it means to white pine management. In the meantime, since blister rust control can't wait, it seems soundest strategy to forge ahead with some program for growing white pine.

POSSIBLE PROGRAMS

It is not feasible to grow white pine on every white pine acre. Thus, one of our big responsibilities, if we go ahead with a permanent program, is to select those drainages which will give the best combination of cost per unit, and quantity and time of yield. Table 9 shows the white pine which could be raised in the Inland Empire and the cost of raising it under different blister rust control cost ceilings. It is based on the management assumptions previously discussed, namely: that the Forest Service will, on those areas where it grows white pine, do all the planting, burning, and other silviculture required to grow white pine at low cost, but that other owners will make no such effort. Turn back to figure 18 on page 81 and you will see that all possible future programs have one weakness in common -- a slump in white pine yield during the coming decades. Figure 18 shouldn't be taken too literally in that it is not a foregone conclusion that the slump will be as great as indicated. This chart is based on the assumption that the principal cutting age will be 120 years. Actually it may be good strategy to cut a number of white pine stands at an earlier age for a period of years in the future and thus lessen the decline. Nevertheless, there is a very important message in figure 18. There is a shortage of white pine stands which would reach rotation

Table 9. Cost of Different Sized Programs With Units Grouped According to Cost Per Thousand Board Feet

Units with future blister rust control cost per thousand board feet of less than	Total first crop[1] yield due to future blister rust control	Future blister rust control and white pine management cost chargeable to first crop[1]	
		Total	Per thousand board feet
Dollars	Billion board feet	Million dollars	Dollars
0.90	14.7	24.8	1.69
1.80	37.5	75.6	2.02
3.60	52.7	127.2	2.41
5.40	55.8	141.4	2.53
9.00	56.7	147.9	2.61
18.00	57.4	157.1	2.74

1/ The first crop of white pine for the purposes of this study is defined as the yield from present young stands, plus the next white pine stands on present deforested areas and on areas now bearing timber more than 80 years of age. Except where otherwise noted, the white pine yields in this and following tabulations are the yields directly attributable to future blister rust control of the scale indicated. The costs likewise are the costs of future work only. Past blister rust control expenditures and the yields attributable to these expenditures are not included.

age 40 to 60 years from now. It is at least 60 years too late to do anything about increasing the number of such stands but the situation can be helped by protecting as many as possible of them even though they are not the cheapest to protect. In other words, priority of units should not be based strictly on cost as was the case in the preceding tabulation. In laying out a program, time and stability of yields should be considered as well.[14] The following pages, therefore, discuss programs based on a priority system which does this. These programs give priority to those <u>units which will produce the largest white pine yield in the next six twenty-year periods for the lowest cost in the next twenty years</u>. In other words, they favor present stands. The following tabulation shows cost per thousand board feet of several programs designed to give most stable production:

Average annual program during next five years -- blister rust control and management	Cost per thousand board feet of white pine produced
Millions of dollars	Dollars
1	2.47
2	2.74
4	3.07
6	2.97
8	2.85

Table 10 and figure 24 summarize the main features of these programs of which the following points deserve special mention:

1. The largest of these programs covers the maximum area on which it is felt white pine forestry can be justified with the kind of management assumed. It covers 1.9 million acres or almost half of the total white pine area in the Inland Empire.

2. By giving priority to units with present stands it will cost more to grow white pine. For example, calculations for programs of approximately the same

14/ On-the-ground planning should also take into account the need for community stability in the individual localities. For example, it would be undesirable to grow all of the white pine in one corner of the region merely because costs are cheaper there.

Table 10. Comparison of Five Sizes of Permanent White Pine Programs Based on Giving Highest Priority to Units Which Will Produce Most White Pine in First Six Twenty-year Periods For Least Cost in Next Twenty Years

Item	Unit	Size of Annual Program First 5 Years -- Million Dollars				
		1	2	4	6	8
Net white pine area	Thousand acres	401	730	1237	1603	1901
Annual sustained yield capacity (white pine)	Million bd. ft. per year	102	183	298	378	448
Total white pine yield first six 20-year periods due to program	Billion bd. ft.	3.0	4.7	6.5	7.2	7.4
Total white pine yield in first crop	Billion bd. ft.	5.3	9.2	16.5	25.3	35.2
Desirable expenditure in next 5 years	Million dollars	5.2	10.5	20.9	29.9	39.4
for blister rust control	Million dollars	4.6	9.2	18.1	24.9	31.8
for management	Million dollars	0.6	1.3	2.8	5.0	7.6
Desirable expenditures in next 20 years	Million dollars	9.8	19.8	40.2	59.8	80.6
for blister rust control	Million dollars	7.6	15.4	30.2	41.6	53.0
for management	Million dollars	2.2	4.4	10.0	18.2	27.6
Total future cost chargeable to first crop	Million dollars	13.0	25.3	50.7	75.1	100.6
for blister rust control	Million dollars	10.5	20.5	40.0	55.8	71.7
for management	Million dollars	2.5	4.8	10.7	19.3	28.9
Cost per thousand bd. ft. of W.P. produced	Dollars	2.47	2.74	3.07	2.97	2.85
Stumpage values attributable to program	Million dollars	41	71	127	202	268
Compound interest return on cost	Percent	1+	1+	1-	1-	1-

Major factors which may affect these estimates are discussed beginning on page 99.

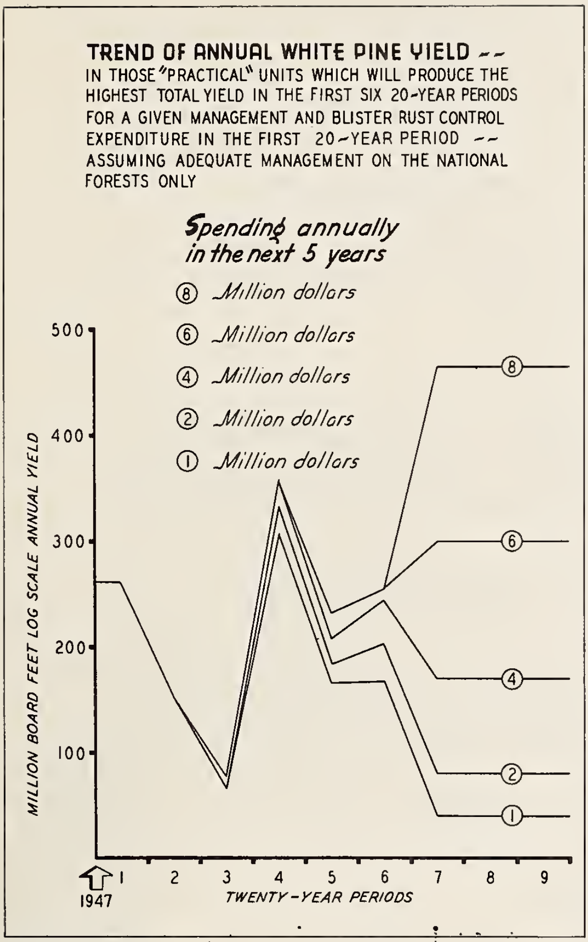


Figure 24.

size under each priority system show that favoring present stands raises the cost about one dollar per thousand board feet over what it would be if priority were based on cost alone.

3. However, by favoring present stands we produce about three times as much white pine during the next 120 years as we would if priority were based on cost alone. Such a priority system will not, however, do much to increase the very low yields in the third twenty-year period. The increase will come in the sixty years after that.

4. In each of the five programs the value of the white pine saved will be 2½ to 3 times greater than the cost of growing it. In each case the investment will yield about one percent compound interest. The smaller programs show a compound interest return slightly over one percent and the larger programs a return of slightly less than one percent.15/

5. The "four million dollar program" (figure 24) buys about as much white pine in the first six twenty-year periods as the 6 and 8 million dollar programs. The great increase in yields from the larger programs would come after that.

15/ As pointed out on page 77 the assumed future stumpage values are conservative. If the differential between white pine and its associated species remains as great as it currently is (1948), the value of the white pine produced by these programs would be as much as six times greater than the costs. In that case the interest return would be almost 2 percent.

6. Assuming a willingness to proceed with a permanent white pine program, the chief limiting factor is the size of investment required during the next few years. From 75 to 80 percent of the management cost and blister rust cost to grow the first crop of white pine comes in the next twenty years. In every case about half of the first twenty years' costs comes in the first five years. The reason for this, of course, is the urgent necessity for controlling the disease just as quickly as possible in those units where white pine is to be grown.

7. The white pine land of all owners was considered in the selection of working units for each program. Because of high cost, however, relatively little non-national forest land will qualify for permanent white pine forestry as long as management practices are as assumed.

FACTORS WHICH MIGHT UPSET ESTIMATES

A question which will come up in everyone's mind is whether sufficient allowance has been made for all the factors, and whether the costs of and values from permanent white pine forestry have been fairly estimated. Time will answer that question, but we can here briefly point out some of the possibilities of error.

Prolonged Delay Will Raise Costs

Blister rust is not lying dormant waiting for us to mobilize the fight against it. The disease is steadily forging ahead, killing trees. The longer we wait before completing the primary control effort in any area, the less of the present white pine which can be saved. In considering any individual unit, it was assumed that if enough work is to be done in that unit to control the disease it will be done as required for maximum effectiveness. Because of the high risk, most of the units with vulnerable stands not now on a maintenance basis should have control work done in them during the first year. The control program would be largest in the first year, gradually tapering off. In such event, taking the region as a whole, the work to be done in the first year would be an enormous and impossible task. Therefore, the cost distribution in this chapter is based on a big control drive spread over the first five years, followed by a small program during the next 15 years and a still smaller one after that.

The first two years of the next twenty-year period have already passed (1947-1948) and a full scale attack has not yet been made. This means that white pine yields during the next six twenty-year periods would probably be below the levels indicated. However, if we get underway before long and if the twenty-year program is completed on schedule, it is not likely that the additional losses due to the delay in getting the program into gear will be sufficiently great to completely upset the estimates presented in this chapter. Obviously, though, if we procrastinate very long, the complexion of the situation will change entirely.

White Pine Yields May Be Lower

Although the white pine and total stand yields used in this study are believed to be on the conservative side, they may not materialize. The rates used may be too high to begin with, or management may be less intensive or less successful than was assumed, or losses from fire, insects, and disease may be greater than expected. There has been too little experience in the actual production of white pine from seed to sawlog to furnish a solid base from which to estimate future yields.

There are several gloomy possibilities which may push yields down but there are also some bright ones which may lift yields up. There has been a deliberate intent to be on the low side in all the yield estimates but not to the extent of scuttling the white pine project before it could be launched. If it were necessary to assume a low order of white pine management, the high per acre costs of blister rust control would tend to kill any thought of a white pine project before it could be given a fair trial. The yields used here, based as they are on multiple cuts, considerable planting and weeding, and successful protection from fire, insects, and disease, are beyond the reach of let-nature-take-its-course forestry but they should be well within the realm of possibility with intensive management.

New Problems May Crop Up

As was stated earlier in this chapter, timber growing in all kinds of forests faces the possibility of attack by some insect or disease which will cause heavy loss. The likelihood of such attacks decreases as stands are brought under management and decadent timber is cut. This danger cannot be eliminated, however.

Our current threat of that nature is pole blight, already discussed. Pole blight is going to result in some loss. It may cause so much loss that the wisest thing to do is to quit growing white pine. That is just a "maybe" though, which some foresters claim is greatly over-emphasized. In any case the thing to do is to (1) go ahead with a permanent white pine program, (2) continue present efforts to learn all about pole blight as quickly as possible, and (3) cross each bridge when we get to it.

The Rate of Damage in Unprotected Young Stands May Be Greater

In this study only the white pine due to blister rust control was used in estimating costs. Therefore, any change in the estimate of the damage caused by the rust will affect the cost of growing a thousand board feet of white pine. At the time this study was made it was assumed that unprotected stands up to about 30 years of age would be completely wiped out in the presence of the rust but that a considerable yield would be obtained from 40 and 50-year-old stands even without protection.

New rate of damage figures developed in late 1948 by Bureau of Entomology and Plant Quarantine men show a much greater rate of loss in unprotected or partially protected 40 to 50-year-old stands than had been indicated by previous information. These new damage rates were obtained by a thorough survey of 20 to 80-year-old stands. The survey indicates that there will be very little yield from white pine stands less than 60 years old which are not fully protected. Therefore, if these new results hold, a greater proportion of future white pine yields from present stands must be credited to blister rust control than the figures in the preceding pages indicate. That in turn would make the cost per thousand board feet of white pine lower than we have estimated.

Future Per Acre Costs May Be Lower

There is a very real chance that blister rust control costs will be greatly reduced. Some blister rust control men think sufficient allowance has not been made for that possibility in this study. Great strides are unquestionably being made in improving ribes eradication techniques through the use of chemicals. In fact, as has already been mentioned, a new chemical is available at the time of this writing which tests indicate will kill all ribes species in the white pine belt at costs below those used in this study.

To the extent that the job involved in eliminating a ribes bush can be whittled, the cost per thousand board feet of white pine will go down.

<u>The Resultant Values May Be Different</u>

Here again is something which cannot be accurately predicted. However, in establishing the "break-even point," an effort was made to be very conservative in estimating future stumpage values. The chances are that good white pine timber, instead of being worth just $5.00 to $7.50 more on the stump than its associated species, will draw a much higher premium. To that extent the break-even point will be higher than has been indicated.

<u>What These Factors Add Up To</u>

Estimated per thousand board feet costs of all 5 programs discussed in the last few pages are only 30 to 40 percent of the stumpage values created. Thus, costs per thousand could increase considerably and still be below the break-even point. Taking into account that factor and the possibility that costs may drop and values increase, we can proceed with reasonable assurance that a white pine growing project is financially feasible.

V. A SUGGESTED POLICY AND PROGRAM

This analysis has attempted to probe and explore in an objective manner some of the most important considerations related to policy. The first four sections of this report give the results of these explorations and lead to several conclusions. First are the conclusions that blister rust control is physically possible and that white pine can be grown at reasonable cost. Second is the conclusion that it is desirable from a national standpoint to grow white pine in the Inland Empire because:

1. The national wood supply situation indicates the country will need all the white pine this region can produce at reasonable cost.

2. It would be a serious mistake to allow any hopes of possible technological advances in wood utilization to divert us from growing adequate supplies of quality timber.

An aggressive blister rust control and white pine growing program in the next few years will bring a substantial quantity of white pine onto the market a half century and more hence when the available supply of virgin soft pine timber in the United States will have declined considerably. It has seemed reasonable to assume, on the basis of several centuries of experience, that white pine will be able to hold or regain its favorable market position because of its special qualities.

The next major conclusion is that the Inland Empire will benefit from the continued production of white pine because it will help insure:

1. Greater prosperity for the lumber industry and the communities of the region in the future.

2. Greater stability during periods of depressed markets.

If substantial quantities of white pine are available for cutting in the future, the economic situation at that time will be better than otherwise even though continued blister rust control will not guarantee the stability of all existing mills in the area.

These conclusions as to the desirability of having the white pine, the fact that it is physically possible to control blister rust, and the calculations that the pine can be grown at reasonable cost lead us to the final conclusion that it is highly desirable to continue blister rust control and white pine growing in the Inland Empire, provided certain conditions are met, as explained below.

MAKE IT A WHITE PINE PROJECT

It seems to us that the cart has been before the horse in the white pine forests of the Inland Empire for a quarter of a century -- a long war has been waged against blister rust in this region without first having definite management objectives. Is the proper objective just the protection of present stands or should the public undertake continuous production of white pine? How much white pine is it desirable to grow? Lacking clear answers to these basic questions, it has been almost impossible to develop a well-aimed, properly balanced, blister rust control program.

The first recommendation which comes out of this study is, therefore, that blister rust control on the national forests no longer be handled as a more or less independent protection job. Plans and programs for control should be completely and tightly coordinated with other management plans and vice versa. There has been a trend in that direction in recent years. From now on it should be a WHITE PINE PROJECT in place of a blister rust control project. As this name implies, the purpose of the project should be to grow white pine. Blister rust control should be one phase of the work -- along with the burning, planting, weeding, fire control, and other measures required to grow white pine at low cost per thousand board feet.

It is not necessary at this stage of the game to make any final decision as to what the ultimate sustained yield goal for white pine should be. As will be shown later, that decision can be postponed for several decades. However, it is the judgment of the authors that the regional and national values wrapped up in white pine will justify setting a rather high goal. It seems to us that, if at all possible, long-range plans should aim at the production of something like 500 million board feet of white pine a year. More than a century would be required to get production to this level. One-half billion board feet of white pine is more than has ever been cut in this region in a single year. It is 60 percent higher than the average cut during the ten-year

period, 1937 to 1946. However, it is in keeping with a national goal of 72 billion board feet annually of all timber.

Though there is no hurry about setting the ultimate goal, it is necessary to decide very soon how much of a white pine project will be undertaken during the next few years and to take immediate steps to avoid additional loss in the present stands included in such a project. In that connection there are two considerations: the size of project which can be handled effectively and the amount of money the public is willing to spend on white pine growing.

Because so much of the work needs to be done in the next five years, the 6 and 8-million-dollar programs discussed in the preceding pages appear too large to be practical. The requirements for manpower and supervision on such a scale probably could not be met. Furthermore, the larger programs would give but little more white pine in the next 120 years than the 4-million-dollar program. Any program up to and including a 4-million-dollar annual expenditure does appear feasible and desirable. A 4-million-dollar program would create a peak employment in the first few years of 7,000 to 12,000 men, unless control methods are revolutionized in the meanwhile. Anyone who has recruited blister rust workers will recognize that this would be a large organization for the Inland Empire, large enough to create a big job of training and supervision. With proper supervision, however, such a program is not too large.

It is recommended that this region undertake the largest feasible white pine project, namely the 4-million-dollar program. The working units which could be covered by such a program would have an eventual sustained yield capacity of 300 million board feet of white pine annually under the management assumptions previously described. If the lands of all owners in these units were managed for white pine, they would have a sustained yield capacity of 430 million board feet of white pine. Thus, to reach a 500 million board foot goal it will be necessary to bring more land into the production of white pine in subsequent periods -- either land in these units or in additional units. Figure 25 shows how that might be done. To obtain the trend of production shown in this graph we would need to spend 30 million dollars in the second 20-year period and a like amount in the third period. After that the cost would drop to 10 million dollars per period or one-half million dollars per year.

The total costs under the above program chargeable to the first crop, or first rotation yield, would be about 51 million dollars. Approximately 127 million dollars of stumpage value would be attributable to this 51-million-dollar expenditure. Thus, the return would be 2½ times the cost.

If it is not possible to obtain 4 million dollars annually during the coming few years, the white pine project should go ahead on whatever scale funds permit. Work should be planned more or less like a series of concentric circles so that regardless of size, the program will be well balanced. For example, if no more than one million dollars is made available annually in the next few years that money should not all be put into protecting present stands. Whatever the scale of program, it should be directed toward producing the most stable permanent flow of white pine it is possible to achieve.

The first responsibility of the Forest Service lies, of

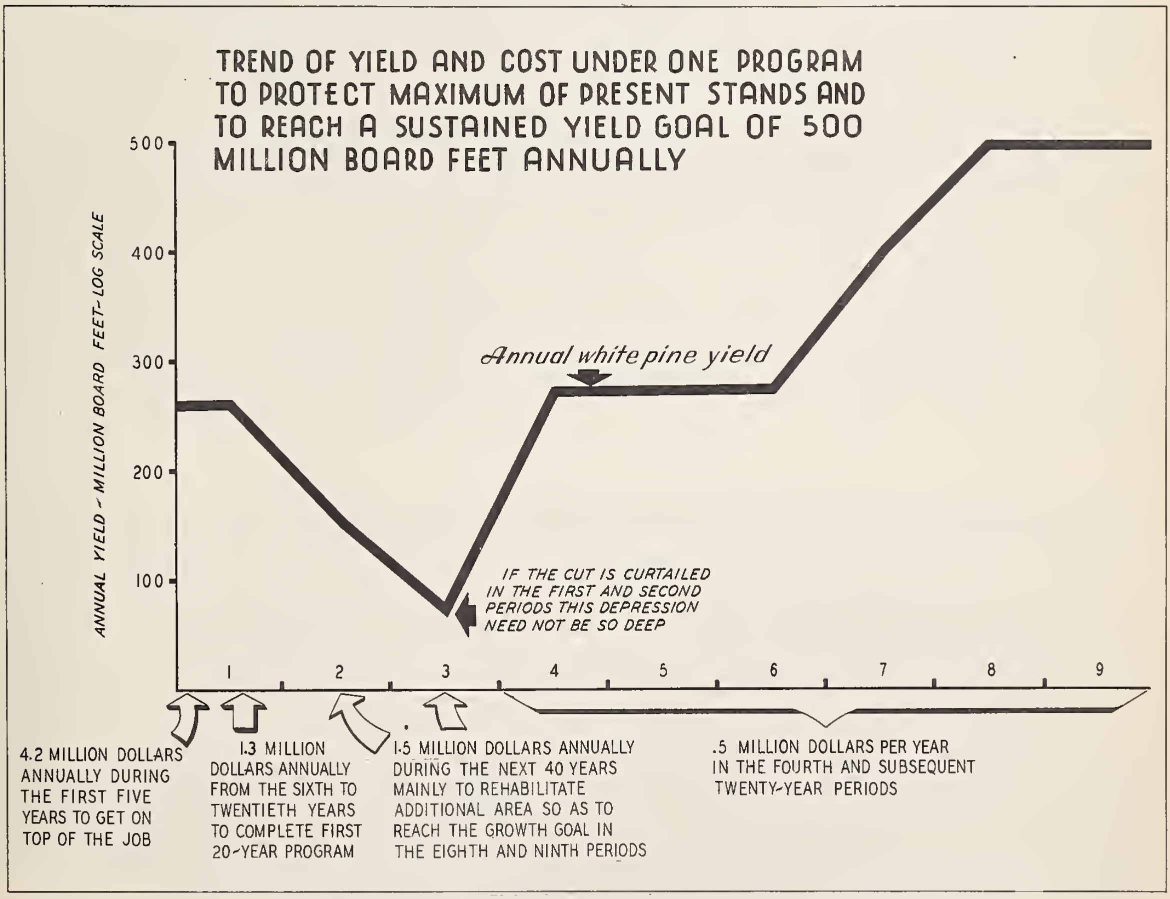


Figure 25.

course, in the national forests. Yet, if it is at all possible, national forest policy should be an integral part of a broader regional white pine policy. Therefore, once the Forest Service has come to a tentative policy decision, a very desirable next step will be to call together the Office of Blister Rust Control, the state foresters, and other interested parties. This group, after considering the situation, should attempt to set up an overall objective. This does not mean that the Forest Service should give up its responsibility for developing a timber growing policy on the national forests. Such open discussions, however, will both promote better management on other lands and make Forest Service policy decisions better suited to the public need.

THE PREREQUISITES

By past standards, the 4-million-dollar white pine project recommended is a very ambitious one. It can be a successful venture also only if there is far greater coordination of effort in the future than there has been in the past. There needs to be a thoroughly unified attack on the problem from all angles.

Stability is a paramount objective in long-term projects such as this where timing is a vital factor. If the Forest Service and the Bureau of Entomology and Plant Quarantine should seek a mandate to proceed with the white pine project on a larger scale, as has been recommended, it certainly seems that they should also reiterate the need for following a long-time budget plan. That may not be difficult if the two bureaus can present a prospectus which clearly defines the objective and the action needed to reach the objective.

The organizational problem should be attacked with all the vigor possible. A small army will be required for ribes eradication in the first few years and all of the old problems of training, supervision, and logistics will require solution. An enlarged program will bog down from sheer weight unless the factors which contributed to past inefficiencies are changed.

For one thing, the growth of the organization should be spread over several years rather than mushrooming to full size in a single year. A three-year buildup, for example, would allow time for recruitment and training of capable supervisors and for the development of plans.

Everything possible should be done to lengthen the effective season. If the number of work days in the season can be substantially increased, the number of men required will be much smaller, training will be immensely more effective, and the cost per man-day will be reduced. It is these advantages which make the six-day work week seem so desirable even though it means paying for overtime work.

The Forest Service must really get down to business in its white pine management because present stands are "perishable goods." It must make and put into operation some carefully worked out plans in the next few years before the opportunity to capitalize on present stands has passed.

The information presented in this report provides a sufficient basis for establishing broad objectives and policies but much more information is needed before detailed plans can be made. The working unit data gathered for the purpose of this analysis are not, in most instances, sufficiently accurate for use in actual plans. Furthermore, only a 50 percent sample was used in this analysis. During the next year or two an intensive study, including such field examination as may be necessary, should be made of all the white pine land in the region which seems to offer any promise for long-term white pine management. All of this land should be subdivided into working units and these units thoroughly analyzed to the end that the information so obtained can be used as the basis for management plans.

In this study the situation has been analyzed from an overall point of view. In actual practice it will be necessary to go into far greater detail, working circle by working circle, taking into account other important considerations such as the needs of local communities.

The working unit has proved to be an exceedingly useful tool in this analysis and is already being used to a certain extent in actual practice. It has much to recommend it for administrative use in white pine management. It is our feeling that blister rust control should, with few exceptions, be planned and applied on a working unit basis rather than on a stand basis. Without a doubt, some of the poor showing of blister rust control in the past had its origin in a diffusion of effort due to the application of protection on a stand basis. The use of working units and the concentration of effort in these units should result in more white pine stands to which we can point with pride and more stands where even the layman can see that blister rust control is accomplishing its objective.

No attempt will be made to mention all the practices that must be developed and coordinated to make a well balanced white pine project. Nevertheless, one item stands out as demanding attention. According to the best information available at this time, fire can be a powerful tool in white pine management. Of special interest here is the fact that fire can be used to reduce blister rust control costs and to make eradication efforts more effective. It also reduces the cost of planting which, in some cases, is impractical without it. Therefore, the program discussed here involves extensive use of fire as a tool of good management. Use of fire on the scale desirable will require not only a clear statement of policy but also the development of technical skill and administrative procedure.

The importance of thoroughly coordinated management in the white pine zone cannot be over-emphasized. In the past planting, blister rust control, and the other aspects of white pine management have not always been closely tied together. The recommended 4-million-dollar program which will involve spending 40 million dollars in twenty years includes 6.1 million dollars for planting, 3.7 million dollars for controlled burning, and a small amount for other cultural work.

<u>The ownership factor</u> should receive its share of attention. Under present conditions of management, the recommended program will be concentrated mainly in units with a high percentage of national forest land. One-third of the area (400,000 acres) would nevertheless belong to the states, counties, and private owners. If the management of these lands can be raised to a high level, the cost of growing the white pine (per thousand board feet) would be decreased and a smaller area would have to be rehabilitated and brought into white pine production during the second and third twenty-year periods to reach the goal of 500 million board feet annually.

There are two ways to get better management on these lands. In some cases a cooperative agreement might be feasible. In other words, in return for protection from the disease the land owner might agree to facilitate control and produce the maximum volume of white pine on his land. Acquisition of the intermingled lands by the Forest Service will probably be highly desirable in many cases where it would be much cheaper to acquire intermingled lands than to attempt to grow white pine on the national forest lands alone.

As part of the white pine project the Forest Service should, therefore, cooperate with other interested agencies and parties in laying out a program for consolidating ownership and raising the standard of management on the lands of all owners. The objective should be to do this within a relatively short time -- say in the first decade.

<u>Much more research</u> is needed on matters relating to ribes eradication. The methods-of-control research being carried on by the Office of Blister Rust Control is particularly important because it may develop new techniques which will reduce costs and manpower requirements. Present hand-pulling methods are too slow, too inefficient, and too expensive to be tolerated any longer than necessary. So much can be gained from the development of more efficient ways of control, that research to find these cheaper methods is the most profitable investment that can be made in white pine management. The Forest Service should certainly do all it can to assure that the Office of Blister Rust Control gets the funds needed to give this problem the attention it deserves.

<u>We can summarize</u> our view this way: White pine is a quality wood which has made and can continue to make an important contribution to the region and the Nation. Its management is, and probably always will be, beset by major handicaps. However, white pine appears to be worth the effort. If that is so, the white pine project in the Inland Empire presents a real opportunity and challenge to everyone in any way responsible for the success of public forestry in the white pine zone.

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2	* Possibilities of partial cutting in young western white pine, by E. F. Rapraeger. Jan. 1940.
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13	Forest resources of northern Montana, by C. W. Brown and W. C. Hodge. June 1948.
14	List of publications available for distribution or loan, 1910 through 1947. June 1948.
15	Review of published information on the larch-Douglas fir type, by Russell K. LeBarron. Nov. 1948.

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